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PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U.S. DEPT. OF AGRICULTURE • FOREST SERVICE

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IN GENERAL

During 1967, regional, national, and world populations continued their seemingly inexorable upward trends.

Along with growth came increasing tensions and anxieties—pressures on our forests and other resources that promised to multiply in the future. Planning for the most productive forests possible to meet accelerating human needs became increasingly urgent.

Pressures for more efficient patterns of forest management, protection, and use reached new highs, as did the demands for the results of research that would help make these goals attainable.

Despite rapid improvements in technology, our problems have grown even faster in number and complexity.

This was the challenging environment of the Pacific Northwest Forest and Range Experiment Station in 1967.

Our output of research results, though small in relation to the demand for them, reached a new high during the year also. Promising leads were discovered and developed that may help solve long-persistent and critical new problems in resource protection, management, and use.

Capacity to produce needed research results was also improved with the Congress providing for strengthening of some high-priority projects at the Station. Among the efforts increased were those in forest engineering, economics, forest recreation, watershed management east of the Cascade Range, and forest genetics research.

Progress was made in improving some much needed research facilities. The new Olympia Forestry Sciences Laboratory was completed in November and occupied in December. This facility is adjacent to the Webster Nursery on a 10-acre site leased from the Washington State Department of Natural Resources. The laboratory provides modern, efficient facilities for the Station's Inten-

sive Culture of Douglas-Fir Project and for scientists of both the Station and the U.S. Bureau of Sport Fisheries and Wildlife, who are studying control of animal damage to forest crops.

Realization of the research potential at the Corvallis Forestry Sciences Laboratory is one step closer. Detailed plans and specifications for construction of the second phase of this facility were completed about midyear. Functional use of wood and wood products is to be emphasized throughout. The 4.9-acre site is leased from Oregon State University and is part of the campus research complex.

Planning of the La Grande Range and Wildlife Habitat Laboratory was completed in May. In September, a construction contract was awarded. The 4-acre site on the Old Oregon Trail is leased to the Forest Service by the Eastern Oregon College of Education. This laboratory will be two-story frame, also emphasizing efficient use of wood products. Expected date for completion is September 1968.

Following pages show the 1967 staff and organization of the Station in outline. The Institute of Northern Forestry is now an integral part of the PNW Station. The adding of this productive unit in Alaska effects a vital dimension for research in the Pacific Northwest.

You will note several key staff changes and additions. **Boyd Wickman**, formerly from the PSW Station in California, is the new leader of the Forest Insects of the Pacific Northwest Project at Corvallis. He succeeds **Kenneth Wright**, now Assistant Director for Forest Protection Research. **Richard Miller**, formerly at the Station's Roseburg unit, is the new leader of the Intensive Culture of Douglas-Fir Project at Olympia, succeeding **Norman Worthington**, retired. **Walter Dahms**, at Bend, is the new leader of the Culture of Interior Coniferous Forests Project, as successor to **Carl Berntsen**, now in Washington, D.C. **John Hendee**, project leader of Wildland Recreation Research at Seattle, is back on the job full time after several

years on educational leave. **James Murphy**, formerly with the Pacific Southwest Station in California, is leader of the new Forest Fire Science Project in cooperation with the University of Washington in Seattle. **Ward Carson**, formerly with Boeing Co., **Joseph Mulcahey** from Washington Iron Works, and **Carl Vigna**, from Bethlehem Steel Corp., joined the Forest Engineering Research Project in Seattle to strengthen the work in balloon and skyline logging. Former Director **Robert W. Cowlin** returned to the Station part time as a consultant to participate in an analysis of timber measurement problems in the Douglas-fir region.

Colin MacLean rejoined the Survey Techniques Project in Portland after a 4-year duty in Nepal with the Agency for International Development.

Patrick Cochran, soil scientist, joined the East-Side Silviculture Project at Bend, Oregon, returning to the Forest Service from a teaching and research position at New York State University College of Forestry at Syracuse.

Robert Campbell, formerly with the Weyerhaeuser Co. at Centralia, Washington, became a key member of the genetics research team at Corvallis.

Nonan Noste moved to the Forestry Sciences Laboratory at College, Alaska, to join the Fire Control Methods Project, transferring from the North Central Station in St. Paul.

Donald Schmiede resumed leadership of the Alaska Coastal Forest Insects Research Project at Juneau, following a year as visiting professor of entomology at the University of Wisconsin.

As in previous years, both scientists and support staff members participated in various training assignments to improve their qualifications for performing more productive research. Seminars, work conferences, library search, on-the-job training, formal academic study—all

were important in the process of personnel development. On an assignment of special interest was **James Trappe**, leader of the Root Diseases and Soil Microbiology Project at Corvallis. He started a year of European study and research on the large group of root fungi known as the Tuberales. Most of his work will be in Turin, Italy, with the authority, Professor Arturo Ceruti, in efforts to better classify these fungi and, eventually, to develop biological controls for root diseases so damaging to forest trees.

Two projects were closed out at the Station during 1967. With the retirement of **William Hallin**, leader of the Silviculture of Southwestern Oregon Mixed Conifers Project at Roseburg, this work was consolidated with Robert Ruth's project at Corvallis, Culture of West-Side Mixed Conifer Forests. With the reassignment and promotion of former Project Leader **Don Flora** to Assistant Director in Portland, the Fire Danger Rating Project was transferred from Seattle to the Rocky Mountain Station in Fort Collins, Colorado.

Two new staff members strengthen the Station's Research Support Services. **Lorne Calvert** came from Washington, D. C., to take charge of Administrative Operations. **Charles Newlon**, recently from Colorado, is filling the new position of information officer at the Station.

In the pattern of previous years, most of the Station's work was done in cooperation with others. Universities, the States, the National Forests, the Bureau of Land Management, other public agencies, and the forest industries all were key participants in the essential task of providing the knowledge needed to better protect, to manage, and to use the Northwest's and Alaska's forests, watersheds, and ranges.

Following in this report are highlights of research developments at the Station during 1967. More detail will be found in the publications issued during the year and listed in the final section. Inquiries and suggestions on any part of the Station's activities are cordially invited.

STATION ADMINISTRATION STAFF PROJECTS AND SCIENTISTS -1967

PHILIP A. BRIEGLEB, DIRECTOR

FOREST SURVEY, FOREST ECONOMICS, FOREST PRODUCTS, MARKETING AND UTILIZATION, AND ENGINEERING RESEARCH

FLORA, DONALD F., Asst. Director (P)¹
4101 Forest Survey — Pacific Coast
 Metcalf, Melvin E., Project Leader (P)
 Gedney, Donald R., Resource Analyst (P)
 Hazard, John W., Assoc. Mensurationist (P)
 Berger, John M., Assoc. Mensurationist (P)
 Oswald, Daniel D., Assoc. Resource Analyst (BC)
 Bolsinger, Charles L., Assoc. Mensurationist (P)
 Wall, Brian R., Assoc. Economist (P)

4102 Survey Techniques — PNW
 Pope, Robert B., Project Leader (P)
 Haack, Paul M., Jr., Mensurationist (P)
 MacLean, Colin D., Res. Forester (P)

4201 Evaluation of Timber Growing Opportunities and Forestry Programs — Pacific Coast

Schallau, Con H., Project Leader (P)
 Chappelle, Daniel E., Princ. Economist (P)
 Payne, Brian R., Assoc. Economist (P)
 Sassaman, Robert W., Assoc. Economist (P)

4301 Improvement of Methods for Marketing Forest Resources

Beuter, John H., Project Leader (P)
 Adams, Thomas C., Economist (P)
 Hamilton, Thomas E., Economist (P)

3602 Wood Construction and Use Concepts

Grantham, John B., Project Leader (S)
 Oviatt, Alfred, Jr., Princ. Research Architect (S)
 Heebink, Thomas B., Princ. Research Engineer (S)

3101 Grade and Quality of Western Timber
 Lane, Paul H., Project Leader (P)
 Henley, John W., Wood Technologist (P)
 Woodfin, Richard O., Jr., Wood Technologist (P)
 Plank, Marlin E., Assoc. Wood Technologist (P)
 Pong, Wee Yuey, Assoc. Wood Technologist (P)

3701 Forest Engineering Systems

Lysons, Hilton H., Project Leader (S)
 Barton, John A., Princ. Physicist (S)
 Mulcahey, Joseph, Industrial Engineer (S)
 Mann, Charles N., Mechanical Engineer (S)
 Binkley, Virgil W., Assoc. Logging Engineer (S)
 Carson, Ward W., Mechanical Engineer (S)
 Vigna, Carl P., Designer (S)

¹ (P) Portland, Oregon
 (C) Corvallis, Oregon
 (B) Bend, Oregon
 (W) Wenatchee, Washington
 (O) Olympia, Washington
 (L) La Grande, Oregon
 (R) Roseburg, Oregon
 (S) Seattle, Washington
 (BC) Berkeley, California
 (J) Juneau, Alaska
 (CA) College, Alaska

TIMBER MANAGEMENT RESEARCH

- | | |
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| <p>MEAGHER, GEORGE S., Asst. Director
(retired) (P)</p> <p>1201 Seeding, Planting, and Nursery Practice — PNW</p> <p>Stein, William I., Project Leader (P)</p> <p>Krueger, Kenneth W., Plant Physiologist (C)</p> <p>Edgren, James W., Assoc. Plant Ecologist (P)</p> <p>1401 Breeding Northwest Trees</p> <p>Silen, Roy R., Project Leader (C)</p> <p>Campbell, Robert K., Princ. Plant Geneticist (C)</p> <p>Sorensen, Frank C., Plant Geneticist (C)</p> <p>Copes, Donald L., Assoc. Plant Geneticist (C)</p> <p>1203 Culture of Coniferous Forests — Interior PNW</p> <p>Dahms, Walter G., Project Leader (B)</p> <p>Barrett, James W., Silviculturist (B)</p> <p>Cochran, Patrick H., Soil Scientist (B)</p> <p>1204 Culture of Mixed-Conifer Forests — West-Side Cascades</p> <p>Ruth, Robert H., Project Leader (C)</p> <p>Herman, Francis R., Mensurationist (C)</p> <p>Franklin, Jerry F., Plant Ecologist (C)</p> <p>Minore, Don, Assoc. Plant Ecologist (C)</p> | <p>1206 Brushfield Reclamation, Prevention, and Ecology</p> <p>Gratkowski, Henry J., Project Leader (R)</p> <p>1207 Intensive Culture of Douglas-fir</p> <p>Miller, Richard E., Project Leader (O)</p> <p>Reukema, Donald L., Silviculturist (O)</p> <p>Williamson, Richard L., Assoc. Mensurationist (O)</p> <p>1208 Animal Damage Control</p> <p>Tackle, David, Project Leader (O)</p> <p>Crouch, Glenn L., Plant Ecologist (O)</p> <p>Dimock, Edward J. II, Silviculturist (O)</p> <p>Radwan, Mohamed A., Plant Physiologist (O)</p> <p>1301 Timber Measurement — PNW</p> <p>Bruce, David, Project Leader (P)</p> <p>Curtis, Robert O., Mensurationist (P)</p> |
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FOREST PROTECTION RESEARCH

- | | |
|---|--|
| <p>WRIGHT, KENNETH H., Asst. Director (P)</p> <p>2103 Fuel Appraisal</p> <p>Fahnestock, George R., Project Leader (S)</p> <p>Morris, William G., Forest Fuels Specialist (S)</p> <p>Lund, Herluf G., Assoc. Photogrammetrist (S)</p> <p>2105 Cooperative Forest Fire Science — University of Washington</p> <p>Murphy, James L., Project Leader (S)</p> <p>2201 Forest Insects of the Pacific Northwest</p> <p>Wickman, Boyd E., Project Leader (C)</p> <p>Mitchell, Russel G., Entomologist (P)</p> <p>Mason, Richard R., Entomologist (C)</p> <p>Sartwell, Charles, Jr., Assoc. Entomologist (P)</p> <p>2204 Nutrition and Behavior of Forest Insects — PNW</p> <p>Carolin, Valentine M., Jr., Project Leader (P)</p> <p>Ryan, Roger B., Entomologist (C)</p> <p>Schmidt, Fred H., Entomologist (C)</p> <p>Coulter, William K., Assoc. Entomologist (P)</p> <p>Daterman, Gary E., Assoc. Entomologist (C)</p> | <p>2203 Diseases of Western Forest Insects</p> <p>Thompson, Clarence G., Project Leader (C)</p> <p>Martignoni, Mauro E., Princ. Microbiologist (C)</p> <p>Wittig, Gertraude C., Microbiologist (C)</p> <p>Maksymiuk, Bohdan, Princ. Entomologist (C)</p> <p>2301 Forest Diseases of the Pacific Northwest</p> <p>Shea, Keith R., Project Leader (C)</p> <p>Childs, Thomas W., Princ. Plant Pathologist (retired) (P)</p> <p>Aho, Paul E., Plant Pathologist (C)</p> <p>Harvey, George M., Plant Pathologist (C)</p> <p>2302 Western Root Diseases and Soil Microbiology</p> <p>Trappe, James M., Project Leader (C)</p> <p>Zak, Bratislav, Princ. Plant Pathologist (C)</p> <p>Lu, Kuo C., Microbiologist (C)</p> <p>Nelson, Earl E., Plant Pathologist (C)</p> |
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WATERSHED, RECREATION, RANGE, AND WILDLIFE HABITAT RESEARCH

HARRIS, ROBERT W., Assistant Director (P)

1601 Water Yield Improvement and Erosion

Reduction — East-Side Cascades

Berndt, Herbert W., Project Leader (W)

Wooldridge, David D., Soil Scientist (W)

Herring, Harold G., Hydrologist (W)

Fowler, William B., Meteorologist (W)

Lopushinsky, William, Plant Physiologist (W)

1602 Erosion and Sediment Reduction —

West-Side Cascades

Rothacher, Jack S., Project Leader (C)

Dyrness, C. Theodore, Princ. Soil Scientist (C)

Fredriksen, Richard L., Soil Scientist (C)

1603 Pollution of Forest Environment

Tarrant, Robert F., Project Leader (C)

Bollen, Walter B., Princ. Soil Microbiologist (C)

Moore, Duane G., Soil Scientist (C)

1701 Range-Environmental Ecology

Garrison, George A., Project Leader (L)

Strickler, Gerald S., Plant Ecologist (L)

Skovlin, Jon M., Range Scientist (L)

1801 Big-Game Habitat — PNW

Smith, Justin G., Project Leader (L)

McConnell, Burt R., Plant Ecologist (L)

Dealy, J. Edward, Assoc. Plant Ecologist (L)

Edgerton, Paul J., Assoc. Plant Ecologist (L)

1901 Wild-land Recreation

Hendee, John C., Project Leader (S)

Burke, Hubert D., Princ. Recreation Specialist (W)

BIOMETRICS

JOHNSON, FLOYD A., Biometrician (P)

RESEARCH SUPPORT SERVICES

PETERSEN, CHAS. J., Assistant Director (P)

Calvert, Lorne M., Operations (P)

Martin, Dorothy E.,

Programing and Statistics (P)

Newlon, Charles J., Information and Education (P)

Knutson, Maurice C., Library (P)

Hansen, George M., Publications (P)

DiBenedetto, A.P., Architecture/Engineering (P)

INSTITUTE OF NORTHERN FORESTRY

HURD, RICHARD M., Director (J)

1210 Culture of Coastal Forests — Alaska

Harris, Arland S., Project Leader (J)

Farr, Wilbur A., Assoc. Research Forester (J)

1604 Erosion and Sediment Reduction —

Alaska Coastal Forests

Helmers, Austin E., Project Leader (J)

Meehan, William R., Fishery Biologist (J)

Swanston, Douglas N., Assoc. Geologist (J)

2206 Forest Insects — Coastal Alaska

Schmiege, Donald C., Project Leader (J)

Hard, John S., Assoc. Entomologist (J)

Torgersen, Torolf R., Assoc. Entomologist (J)

4103 Forest Survey — Alaska

Hutchison, O. Keith, Project Leader (J)

Laurent, Thomas H., Assoc. Research Forester (J)

Hegg, Karl M., Assoc. Research Forester (J)

LaBau, Vernon J., Assoc. Research Forester (J)

1211 Ecology of Subarctic Trees and Forests

Gregory, Robert A., Project Leader (CA)

Viereck, Leslie A., Botanist (CA)

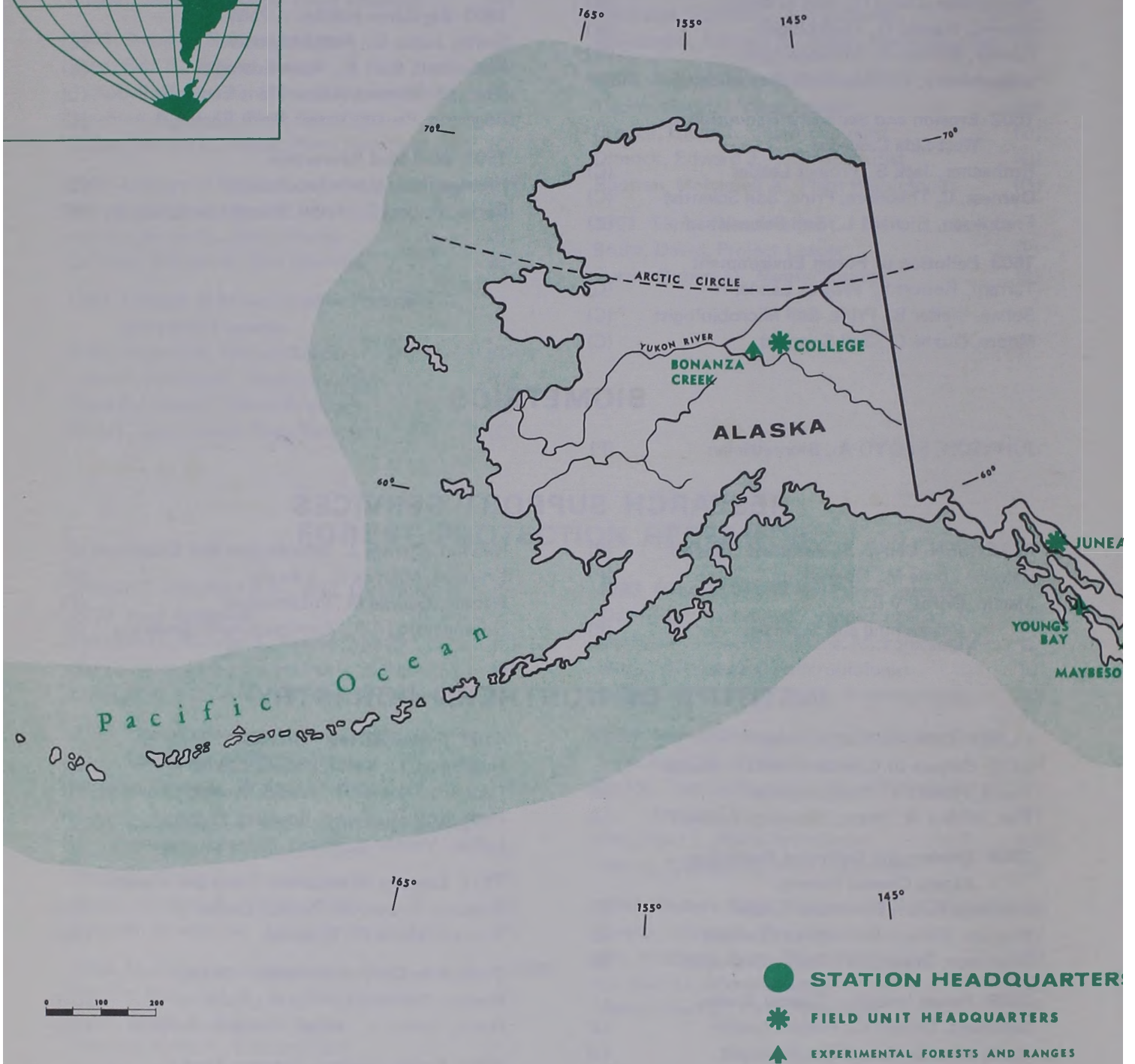
2106 Fire Control Methods — Alaska

Barney, Richard J., Project Leader (CA)

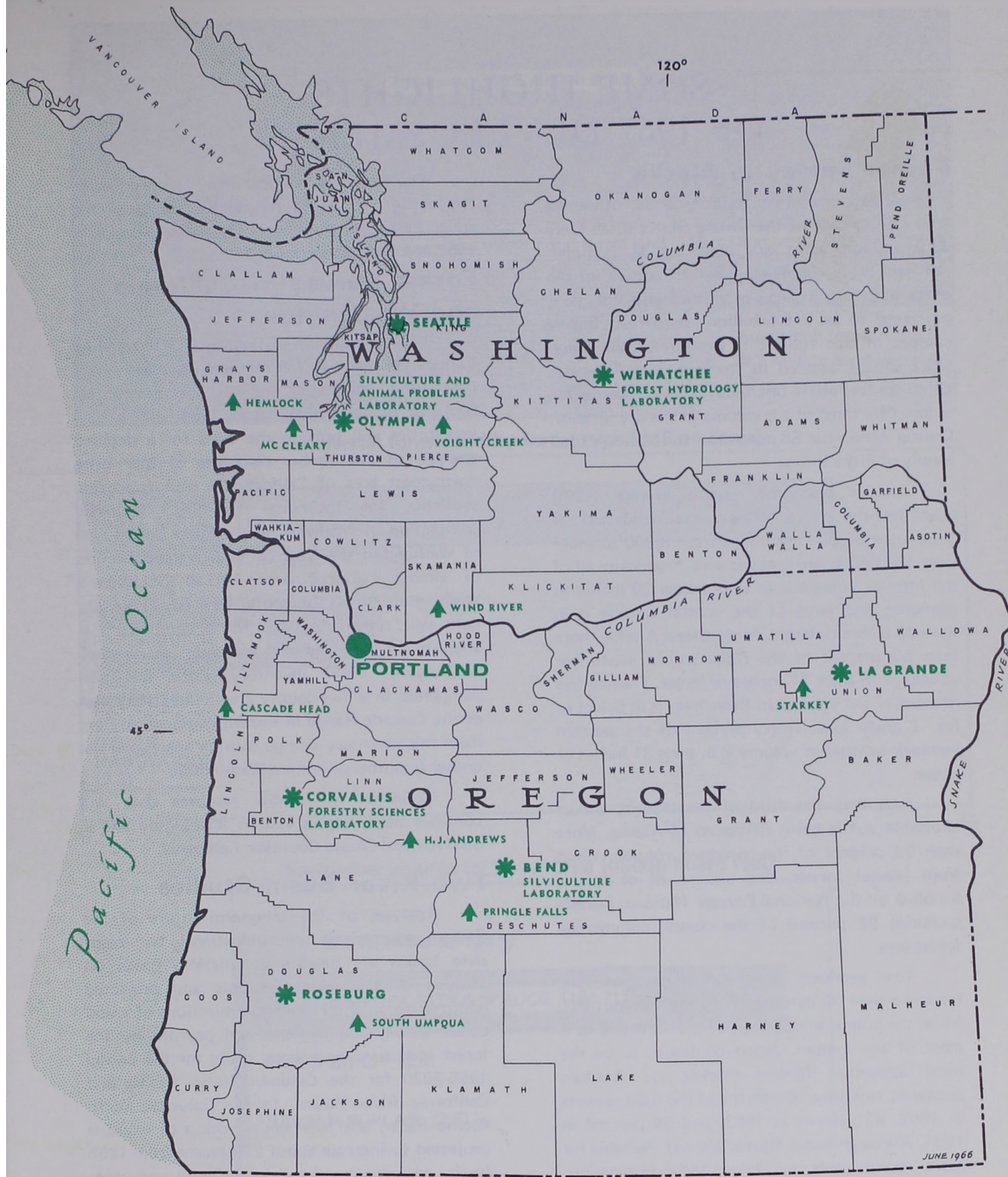
Noste, Nonan V., Assoc. Research Forester (CA)

2207 Forest Insects — Interior Alaska

Beckwith, Leroy C., Project Leader (CA)



PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE ... U. S. DEPARTMENT OF AGRICULTURE



SOME HIGHLIGHTS OF 1967 DEVELOPMENTS

Forest Survey in Alaska

Alaska has 119 million acres of forest land—16 percent of the United States total. Only 28.2 million acres are classified as commercial—still more commercial forest than any of the other 49 States. Alaska's total sawtimber volume is estimated to be 215.5 billion board feet. Eighty percent of this volume is western hemlock and Sitka spruce, located in the wet coastal region. White spruce, paper birch, cottonwood, and aspen account for most of the volume in the dry interior. Coastal Alaska has 88 percent of the Nation's total supply of Sitka spruce.

Interior sawtimber stands average 3,270 board feet per acre, whereas coastal stands average more than 30,000 and range from 8,000 to more than 100,000 board feet per acre. Practically all of the interior volume is in trees below 20 inches in diameter, and most of the coastal volume is in trees 20 inches or larger. In southeast Alaska, more than 50 percent of the Sitka spruce sawtimber volume is in trees 31 inches or larger. Twenty-five percent of the volume in these trees is in Select or No. 1 grade logs. Thirty percent of the western hemlock sawtimber volume is in trees 31 inches or larger.

Less than one-third of the present annual allowable cut is being harvested in Alaska. More than 99 percent of the harvested volume comes from coastal forests, and almost all of this is supplied by the National Forests. National Forests comprise 92 percent of the coastal commercial forest area.

Two products—pulp and lumber—account for more than 99 percent of the log volume used. All of the pulp is shipped out of the State and so is most of the lumber. Japan continues to be the most important foreign market for Alaska's products, receiving 76 percent of the total exports in 1962, 82 percent in 1963, and 89 percent in 1964. Although exact figures are not available for more recent years, we know these proportions have been rising. Wood products with a value of \$29,708,000 amounted to 83 percent of the total Alaskan export in 1964.

The Station's publication, "Alaska's Forest Resource," reports in detail the results of the aerial fieldwork completed for coastal Alaska in 1962 and for the interior in 1960.

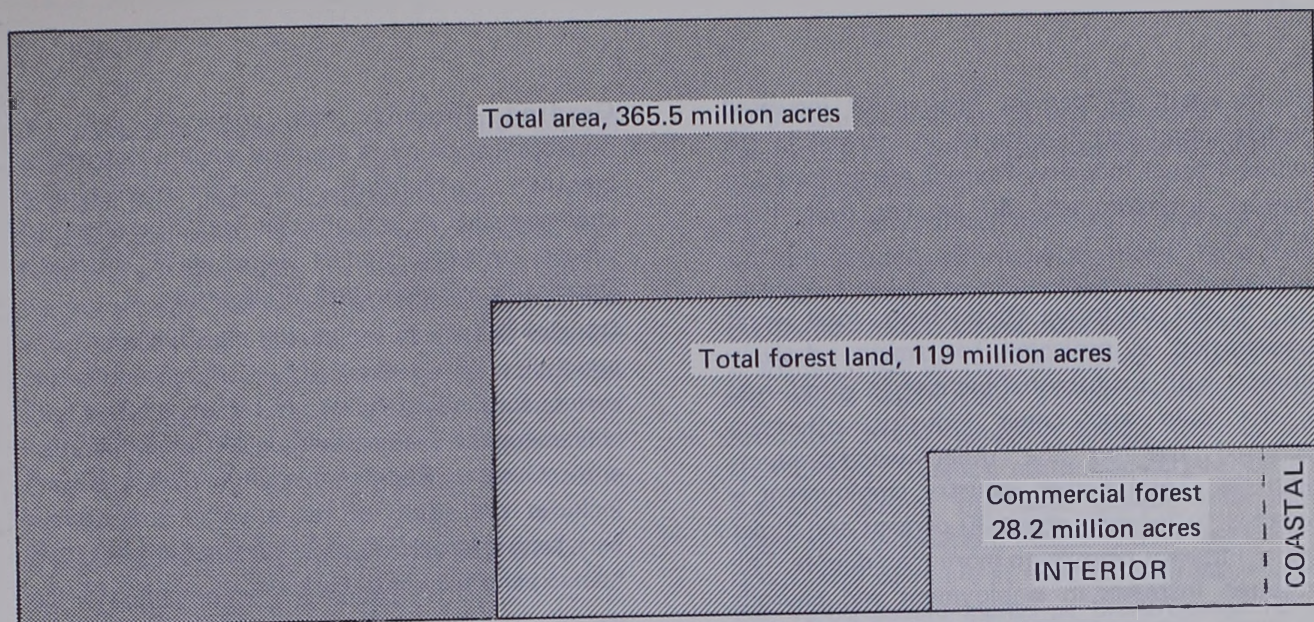
Forest Survey in California and Washington

With completion of fieldwork in Mendocino County this year, timber resource inventories have now been completed for all the north-coast counties of California since 1964. These new inventories will provide the basis for a detailed analysis of the timber resources of the entire north-coast area of California as well as provide statistics for individual counties. Similarly, completion of fieldwork in the Puget Sound area of Washington this year completes the collection of timber resource data for all of western Washington during the period 1963-67. These new data will provide a basis for a comprehensive analysis of the timber resources of western Washington. Field inventory work was also completed in a five-county area immediately east of the Cascade Range in eastern Washington. Data from this inventory will go into an analysis of the timber resources of eastern Washington.

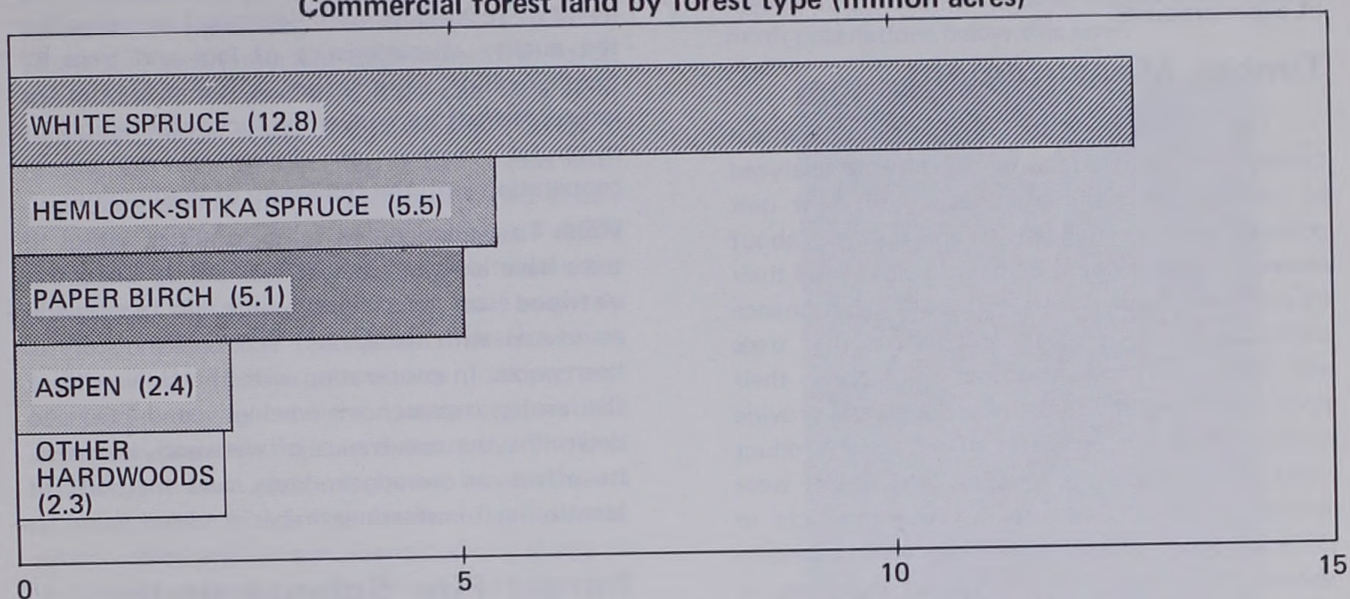
Collection of timber resource data will continue next year in eastern Washington and in Siskiyou and Shasta Counties, California.

Two River Basin Studies

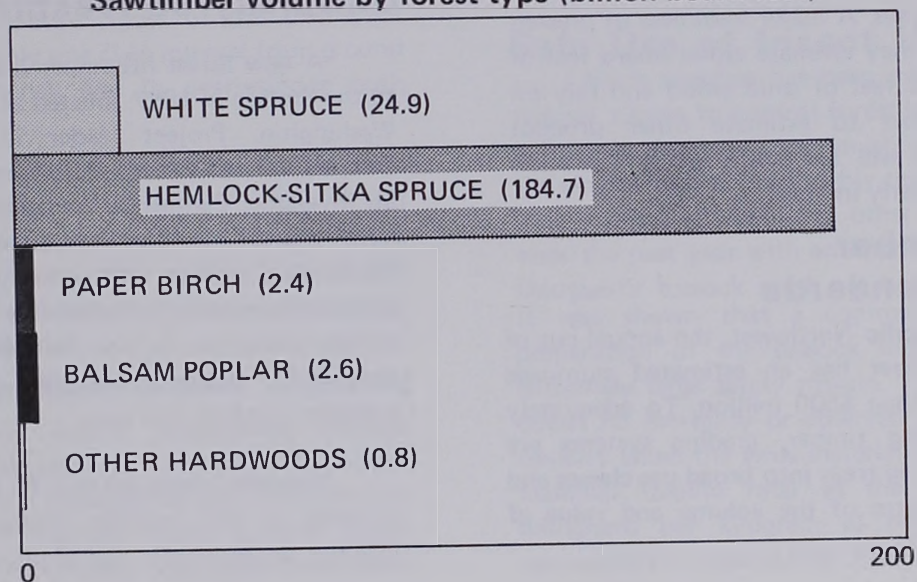
Analyses of the long-term future of the timber resources and forest industries in two major river basins are nearing completion. Based on analysis of the forest resource and projected national demand for timber, projections of wood consumption, employment, and payrolls by the forest industries have been made for the period 1965-2020 for the Columbia-North Pacific and California River Basins. In the Columbia-North Pacific Basin, the total consumption of wood is projected to increase about 22 percent from 1965 levels, with increased use in the pulp and paper industry offsetting declining use by other wood-using industries. Over the same period, total timber industry employment is expected to



Commercial forest land by forest type (million acres)



Sawtimber volume by forest type (billion board feet)



The forest resource of Alaska.

decline about 37 percent because of increased mechanization and in spite of an increase in the pulp and paper industry. Payrolls are projected to increase approximately 50 percent over 1962 levels.

In the California River Basin, total wood consumption is projected to remain relatively constant with a substantial increase in wood used in the pulp and paper industry, offsetting decreased use by the other wood-products industries. Total timber industry employment is expected to increase about 30 percent and direct timber industry payrolls to more than double. The projected increases in employment and payrolls are largely due to anticipated increased fabrication of paper products.

Timber Measurement

In a special study, timber measurement problems in the Douglas-fir region were analyzed by interviewing representatives of different user groups. Their experience with and opinions about current measurement systems were noted and their objectives and standards of performance summarized. The analysis emphasized that trees and logs usually are measured to establish their price; therefore, the measurements should provide a logical basis for estimates of potential product yield. Log dimensions, quality, and defect were found to affect yields of various products in different ways. An optimum measurement system should accordingly provide direct estimates of effect of each of these three factors on all alternative end uses. A major weakness of present systems is that they estimate either board feet of lumber or cubic feet of solid wood and rely on converting factors to estimate other product yields. Findings will be published as a Station Research Paper early in 1968.

Better Timber Quality Standards

In the Pacific Northwest, the annual cut of commercial timber has an estimated stumpage value of more than \$500 million. To adequately appraise standing timber, grading systems are needed for sorting trees into broad use classes and providing estimates of the volume and value of their end products.

Grading.--Research was continued on the development of more accurate grading systems for western softwoods by relating timber characteristics to end-product yield. Lumber and veneer recovery studies were made on coast Douglas-fir, white fir, and Sitka spruce.

Douglas-fir bark in log quality classifications.--The possibility of developing a quality classification system for Douglas-fir logs and trees based on bark characteristics is being investigated in cooperation with Oregon State University. This research includes the study of the physical structure of bark and is providing new information that may help expand the use of bark.

Photographs of veneer record log quality.--Techniques were developed for recording the quality characteristics of logs and trees by photographing green veneer as it comes from the lathe. Methods for converting such information for computer analysis are being investigated in cooperation with the University of Washington.

White fir wetwood.--In some localities, white fir trees have a serious defect, commonly known as wetwood or blackheart, that is apparently associated with decay and excessive moisture in heartwood. In cooperation with the University of California, research is being conducted to determine the occurrence of wetwood, its cause, its effect on wood products, and methods of identifying it in standing timber.

Forest Fire Science at the University of Washington

A new forest fire research project was added to the Station in 1967, located at the University of Washington. Project leader is Dr. James L. Murphy, formerly of the Fire Research Laboratory at Riverside, California. A main objective of the new project is to assist the University of Washington College of Forest Resources develop graduate programs in forest fire science. Another project objective is the initiation of a strong cooperative research program in forest fire behavior, control, and use.

Presently there are two Ph.D. and two M.S. students in the program. Research in progress includes an economic and statistical study aimed

at producing decision aids for fire control administrators, based upon burning-index probabilities, and a statistical study of slash burning guidelines. The slash study indicates that chances are slim that the burning job can be completed each fall in western Washington. By the time enough rain has fallen to reduce the fire hazard, there is a low probability that storms will stop long enough to allow fuels to dry so that they can be burned. Chances are good, however, that burning can be done during the winter and again in the spring.

Photographic Measurement of Understory Fuels

Aerial color photography shows promise for estimating height and density of understory vegetation, two important determinants of forest fire behavior. We used true color and false color (infrared) film at scales of 1:2,000 and 1:3,500 to photograph two dense Oregon oak stands with deciduous woody understories that varied widely in height and density. Natural color at 1:3,500 proved to be the best film/scale combination, but it appeared that a somewhat larger scale might do equally well. The interpreter developed a technique of "stereo stare" for looking past overstory crowns and concentrating on the understory beneath holes in the canopy. The best results came from combining photo measurements of brush height with interpretation of appearance, mainly color and texture. Seventy-five percent of the understory density estimates and 46 percent of the height estimates fell within the same classes as ground determinations. Most of the discrepant estimates were only one class interval from ground truth. The tendency was to overestimate both height and density.

If we can perfect techniques for accurate photo interpretation of understory fuels, we will be well on the way toward a much-needed capability for rapid appraisal and mapping of fuel types over large areas where a forest canopy partly obscures the basic fuels.

Insect Populations and Control

Studies of insect populations provide information as to when it is necessary to control injurious insects in managed forests. To determine the factors that regulate insect numbers under different forest conditions, population levels need

to be estimated annually. But first, practical field methods have to be developed for estimating the size of populations.

In recent studies, numbers of eggs and larvae of the Douglas-fir tussock moth have been estimated accurately at both low and high population levels. To estimate egg numbers, entire branches must be representatively sampled from the whole tree crown. Larval numbers can be estimated from midcrown foliage samples only (see photo). Tussock moth populations vary in intensity within the same general infestation. Significant defoliation, however, does not seem to occur until there are at least 25 early instar larvae per 1,000 square inches of branch area. To be effective, control techniques should keep tussock moth populations below this level.



Safe Use of Insect Viruses

Much progress has been made toward using natural viruses to control forest insects. However, before they can be used on an operational basis, the viruses must be thoroughly tested to determine their effects on man and other animals. Safety tests the past year with an important virus of the Douglas-fir tussock moth are highly encouraging. It was shown that a commercially produced preparation of the tussock moth virus has an extremely large safety margin. Feeding tests produced no mortality or observed signs of systemic toxicity when the virus material was ingested by a mammal (albino rats) at the rate of 10,000 milligrams per kilogram of body weight. The mammalian-to-insect-LD50 (the dosage necessary

to kill 50 percent of the test animals exposed) ratio of the industrial virus preparation is greater than 900,000:1. Even these figures do not show the complete safety of the virus material, since they reflect the maximum amount of virus material that could be administered to the test animals with the test procedures used; at this level, no mortality or systemic toxicity was observed. In the case of DDT, one of the most commonly used chemical insecticides, the mammalian-to-insect-LD50 ratio varies between 22 and 105:1. This comparison demonstrates the safety margin of the tussock moth virus.

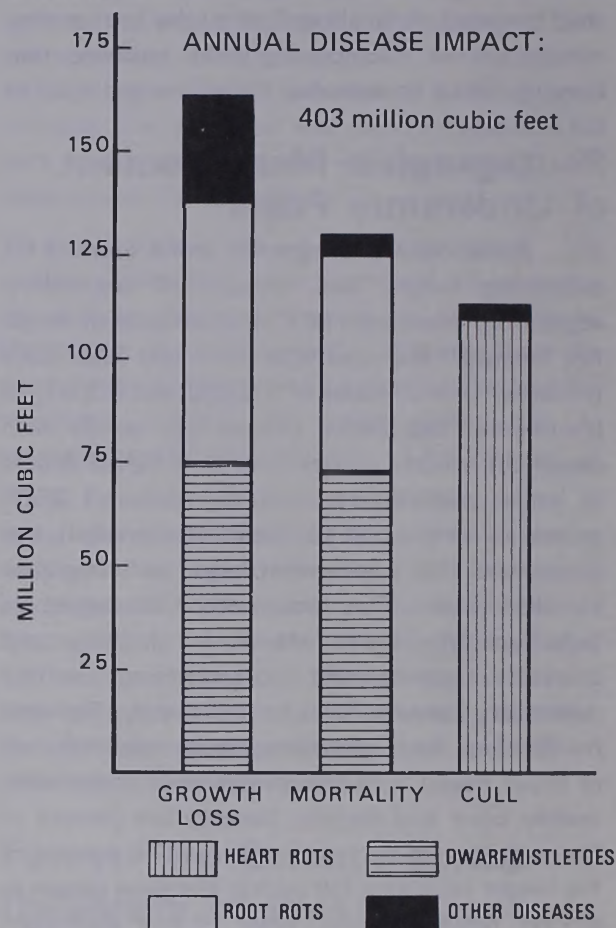
Metabolic Disorders in Forest Insects

Metabolic disorders can cause insect populations to be self-regulating. Thus, an important aim of our insect physiology studies is to detect, identify, and determine the incidence of these disorders in harmful forest insects. Among spruce budworm (*Choristoneura* spp.) larval populations, a green form appears to be self-regulating; its outbreaks subside without causing serious damage. Color differences in budworm larvae are due chiefly to two chromoproteins, one blue and the other yellow, in their blood. This year, the blue part of the blue chromoprotein was shown to be a bile pigment of the mesobiliverdin type; concentrations of this bile pigment appear to be greater in the green form. It is suspected that the bile pigment production is tied in with the chemical processes of respiration through a protein called cytochrome. If so, an abnormal concentration may reflect a disorder in the respiratory system, thus providing a means of identifying essentially "sick" budworm populations.

Disease Impact on Forest Production

Diseases seriously reduce forest productivity in Oregon and Washington forests. Annual disease impact in the two States is estimated at 403 million cubic feet (3.1 billion board feet). About 169 million cubic feet of loss occurs in east-side and 234 million in west-side forests. Growth loss is the largest item (162 million cubic feet), followed by mortality (129 million) and cull (112 million). Leading causes are dwarfmistletoes (148 million), root rots (115 million), and heart rots (110

million). Annual disease impact is 139 million cubic feet in Douglas-fir, 88 million in western hemlock, 62 million in true firs, and 40 million in ponderosa pine. In addition to pointing up the damage caused by forest diseases, these recently published statistics will be used as a basis for setting disease research priorities at the PNW Station.



Fungi Attack *Poria weirii*

A soil survey of a *Poria weirii* root rot area has turned up some new biological allies. Five principal antagonists of *Poria weirii* comprised about 6.7 percent of all fungi counted over the 2-year sampling period. Laboratory studies have shown that isolates of *Trichoderma viride*, *Pestalotia* sp., *Gliomastix chartarum*, *Cephalosporium acremonium*, and an apparent mutant of *Penicillium humuli* are detrimental to development of *Poria weirii*. We hope to determine ecological conditions favorable to these beneficial fungi, and then regulate these conditions to favor antagonist development. The purpose: biological control of *Poria weirii*.

Snow Water Without Snowstorms

Winter frost contains moisture, not measurable by ordinary means, that affects the supply of water for forest vegetation and people in homes and industries downstream. In the winter, windblown fog forms supercooled droplets that settle as hoarfrost or rime ice upon contact with needles, branches, or other obstacles.

This form of precipitation contributed nearly 2 inches of water during the 1966-67 winter at a 6,000-foot-elevation study site in the mountains east of the Cascade Range. There were 30 days of riming conditions during the winter. Preliminary results show that the average lodgepole pine tree in the stand traps slightly more than 60 pounds of rime ice per day when winter fog is present. Continuing work will quantify the volumes of rime ice trapped during and immediately following snowfall.



More Water After Logging

Harvest of 10 billion board feet of timber annually in western Oregon and Washington removes most of the growing vegetation from about 200,000 acres. When all merchantable timber was harvested from a small experimental watershed in western Oregon, annual yield of water increased over 40 percent. More important, a portion of this increased yield came at the lowest flow period when streamflow is most in demand for domestic, industrial, and irrigation use and for pollution abatement. If all the increased water from the 400,000 acres clearcut within the last 2 years could be used during the low flow period, the increase would supply the daily needs of at least a hundred thousand people with no additional storage.

Douglas-Fir and Animal Food Preferences

As the need for more productive coexistence between timber and wildlife resources grows, research in animal damage control is giving increased emphasis to relationships between animals and their food supplies. Chemical components of shrubs and herbs that are principal foods of black-tailed deer are being analyzed to identify the critical chemical factors that influence forage preference and rates of consumption. In another series of studies, we have for the first time shown conclusively that different genotypes of Douglas-fir vary widely in attractiveness as food for black-tailed deer and snowshoe hare. In winter trials on captive animals in semiwild environment, certain genotypes were as much as 2-1/2 times more attractive as food than others. Research on this lead toward genetic control of animal damage in Douglas-fir is underway.

Impregnating Douglas-Fir

Seed With Endrin

Since its introduction in 1956, endrin has been widely used for coating tree seed in Northwest aerial seeding operations, but the results have varied widely. We are exploring the possibilities of impregnating seed with endrin, since this kind of treatment should use smaller

amounts of the chemical than a seed coating and should be safer and more effective. Impregnation should also be more lasting than coating since endrin would be inside the seed and protected from weathering until eaten by rodents. Laboratory tests show the new treatment affords improved protection without impairing germination. Further tests in both laboratory and field will be carried out to complete the evaluation.

Logging and Salmon Spawning

Concern about the effects of timber harvesting on salmon streams in southeast Alaska led to a 17-year study of these relationships on Prince of Wales Island. The main research area included two streams from watersheds that were logged during the course of the study and one from an unlogged watershed for comparison.

Measurements of various stream physical factors indicated no evident changes in streamflow in response to clearcutting. Analysis of rainfall in relation to streamflow failed to indicate that clearcutting affected streamflow characteristics during stormflows.

Suspended sediment remained at low levels throughout the period of record. Generally, sediment concentration increases with increasing streamflow. Within the limits of our sampling, however, it did not appear that logging significantly affected the relationship between suspended sediment concentration and streamflow. We believe that road construction and postlogging debris avalanching probably did cause increased stream sedimentation. If so, the effects on water quality evidently were small and brief.

It is possible that removal of streamside timber is the most significant factor altering stream temperature through increased solar radiation during the summer and exposure to colder air during the winter. The maximum effect was 4° F. or less in the study streams. The maximum recorded temperature in any of the study streams was 69° F.

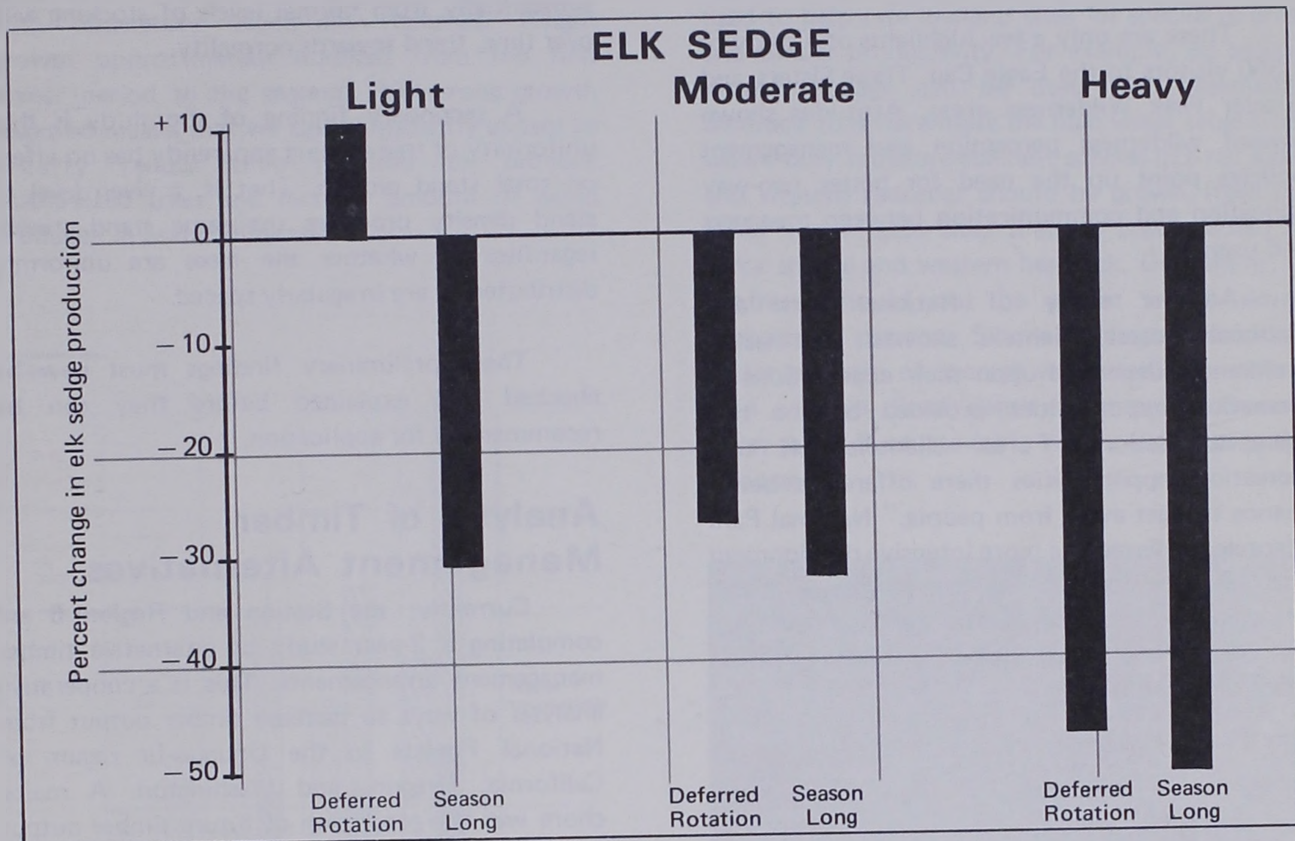
Our conclusion is that in southeast Alaska, timber harvesting, carefully done, can be compatible with salmon production. A detailed report will be issued in 1968.

Cattle Stocking and Forage

Summer grazing at three levels of stocking—20, 30, and 40 acres per cow and calf—reduced elk sedge production 20, 14, and 6 pounds per acre. These preliminary results were obtained from the recently completed 11-year grazing management study at the Starkey Experimental Forest and Range in the Blue Mountains of Oregon. Elk sedge is one of the most important forage plants on ponderosa pine ranges for deer and elk as well as livestock.

Losses in elk sedge production were significantly greater under season-long grazing (40 percent) than under the deferred-rotation system (25 percent). At the low level of stocking, there was a 10-percent gain for elk sedge under deferred-rotation grazing, whereas there was a loss of 30 percent under season-long grazing (see graph).

Managers of forested grazing lands need to consider carefully the impacts of distribution practices designed to obtain increased use of timber forage such as elk sedge.



Young Bitterbrush Needs Protection

Bitterbrush plantings on deer winter ranges often fail because they are overused before they have a chance to mature and because they cannot thrive under the severe competition from surrounding vegetation. Removing competing vegetation increased bitterbrush production 12 pounds per acre and protection of immature plants from browsing brought an increase of 20 pounds. The combination of protection plus release from competition provided a whopping gain of 80 pounds per acre.

These responses were from 6-year-old plants which had been treated only two growing seasons and which averaged only 9 pounds per acre before treatment as a result of 75-percent average annual use. Grazing capacity, based upon bitterbrush, was about 2 deer-days per acre on the untreated area as compared with approximately 18 deer-days under the combined treatments—a ninefold increase. Results of this study are applicable to about 2 million acres of bitterbrush range in Oregon that need improvement.

Wilderness Users Express Wildernism

Almost five out of 10 respondents to a wilderness-user questionnaire did not feel that use of wilderness-type areas has to be restricted to limited numbers of people. Many users felt that they should camp wherever they pleased and should have the right to shortcut trails. Practically all visitors agreed that man-caused fires in wilderness should be extinguished as soon as possible; nine out of 10 agreed that lightning-caused fires should not be allowed to run their natural course.

These are only a few highlights of a study of 1,350 visitors to the Eagle Cap, Three Sisters, and Glacier Peak Wilderness areas. Attitudes shown toward wilderness perception and management policies point up the need for better two-way education and communication between managers and users.

Another study of National Park and National Forest clientele showed that users' preferences depended upon their expectations of recreation opportunities provided by the two agencies. National Forest clientele felt that recreation opportunities there offered a better chance to "get away from people." National Park clientele preferred the more intensive development and supervision those areas receive. This knowledge of users' expectations should help both Park Service and Forest Service to fulfill recreation needs of clientele.



Douglas-Fir Stand Growth

Analysis of Forest Survey plots in even-aged young-growth Douglas-fir sheds some interesting light on the relationship of stand growth to stand density. The results indicate that as stand density increases, both gross and net cubic-foot growth rise at a relatively constant rate, showing no tendency to reach a peak or level off. This finding is contrary to the general belief that there is a broad range of stand densities that produce essentially the same total growth. It also seems to contradict the idea that stands that depart substantially from normal levels of stocking will, over time, trend towards normality.

A secondary finding of the study is that uniformity of tree spacing apparently has no effect on total stand growth. That is, a given level of stand density produces the same stand growth regardless of whether the trees are uniformly distributed or are irregularly spaced.

These preliminary findings must now be checked and explained before they can be recommended for application.

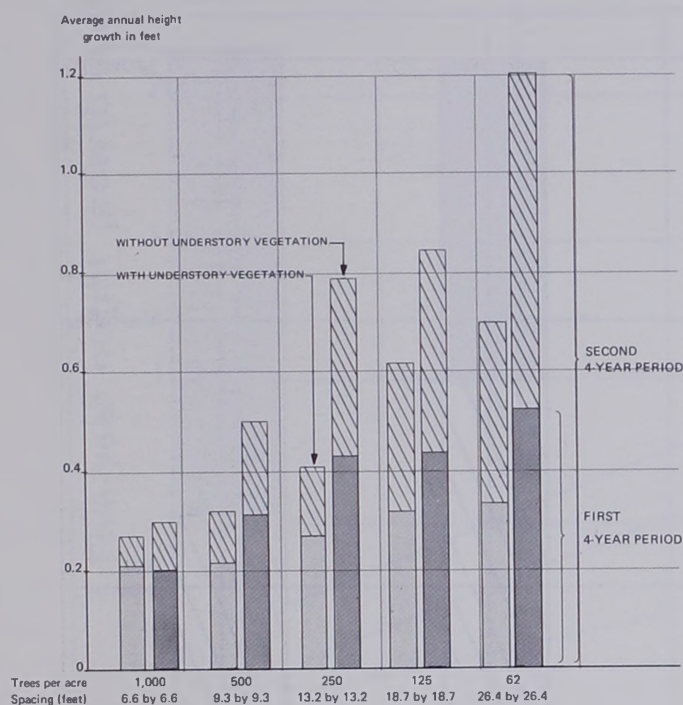
Analysis of Timber Management Alternatives

Currently, the Station and Region 6 are completing a 2-year study of alternative timber management arrangements. This is a cooperative analysis of ways to increase timber output from National Forests in the Douglas-fir region of California, Oregon, and Washington. A major chore was the projection of future timber output when one varies regeneration expenditures, thinning intensity, rate of road construction, and time to convert old-growth to young-growth timber. This phase of the study was greatly facilitated with a computer program for calculating allowable cuts by the volume regulation method. The program was developed by the Station's long-term study of National Forest Timber Management Decision Systems (TIMADS).

Hikers near Broken Top in the Three Sisters Wilderness.

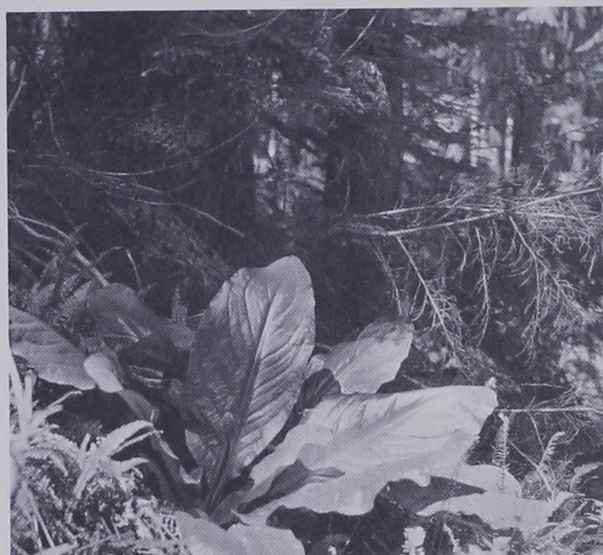
Ponderosa Pine Response to Culture

Growth response of once-suppressed ponderosa pine saplings to thinning and removal of understory vegetation at Pringle Falls near Bend, Oregon, has been dramatic during the past 8 years. Average annual growth rate over the most recent 4-year period has ranged from 0.14 inch in diameter and 0.28 foot in height at 1,000 trees per acre with understory present to 0.6 inch in diameter and 1.2 feet in height at 62 trees per acre with understory vegetation removed. Height growth approximately doubled from the first 4-year period to the second. This strong growth response means that we can confidently expect to greatly reduce time required to produce usable-sized trees and increase amount of wood produced in usable dimensions.



Skunk Cabbage and Water Table

A recent study in Oregon coastal forests shows that skunk cabbage occurrence, abundance, and petiole length are closely related to average depth to water table during winter and early spring. Depth to water table, in turn, is the dominant factor that determines which tree species will grow in wet lowland areas in western Oregon and Washington. Observations and measurements of skunk cabbage can, therefore, be used to help rate lowland sites for species to grow and timber productivity. For example, we believe skunk cabbage can be used with reasonable accuracy to differentiate the high water table sites, where only moisture-tolerant species like red alder and western redcedar should be grown, from the lower water table sites that are best adapted to Sitka spruce and western hemlock. Douglas-fir, in contrast, should not be grown where skunk cabbage is present. Skunk cabbage provides a better measure of average water table conditions than a single direct depth measurement because water tables fluctuate fairly widely even during the wet season.



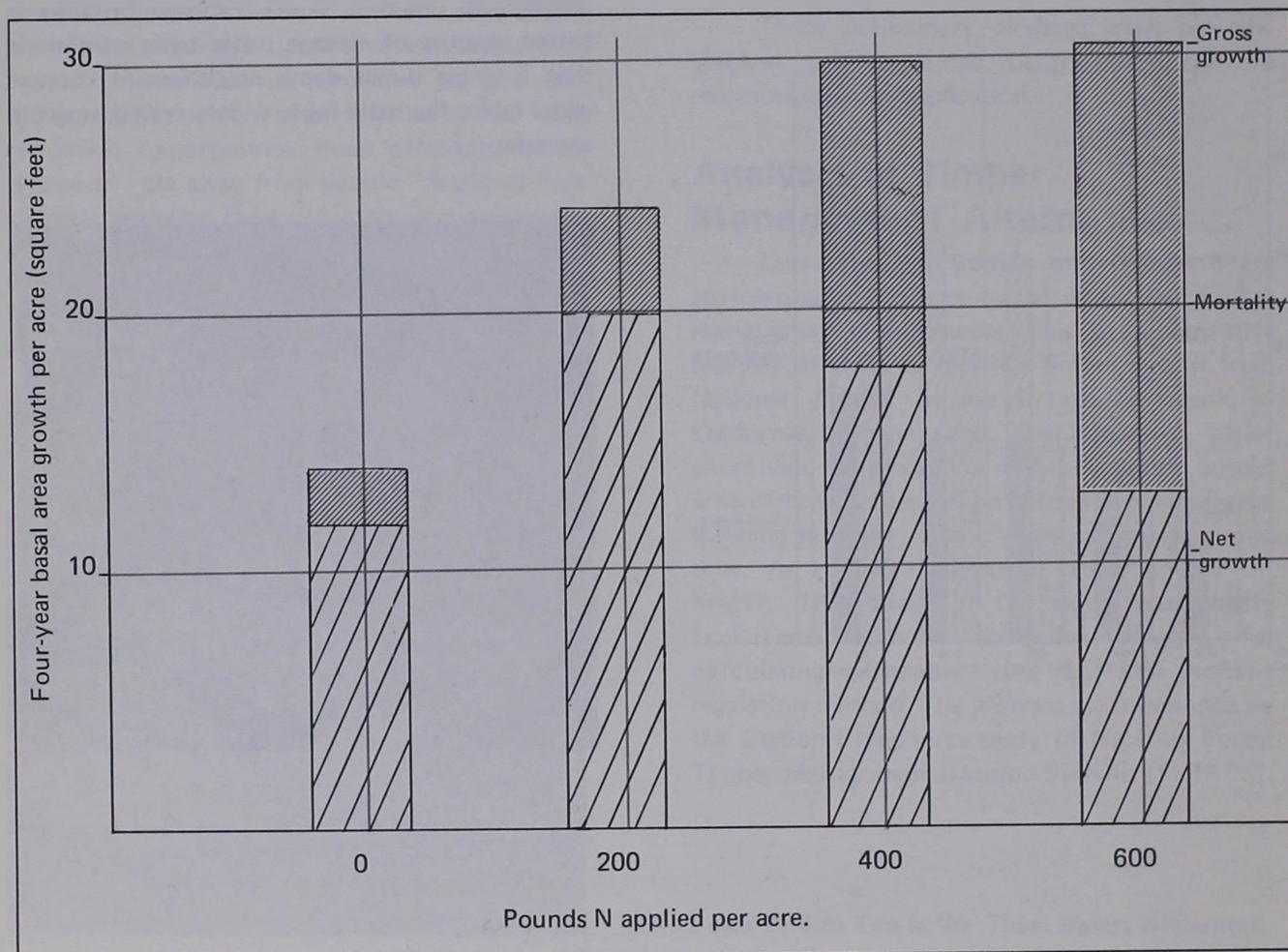
Why Alder Seedlings

Grow So Well

Growth of red alder seedlings is truly impressive, whether the forest owner wants to grow alder as a commercial crop or discourage it in favor of conifers. Second-year seedlings of red alder, Douglas-fir, Sitka spruce, and western hemlock were found to have comparable photosynthetic rates at moderate light intensity and to distribute their growth similarly among leaves, stems, and roots. However, red alder was found to use high light intensity better than the conifers. The leaves of red alder, moreover, provide a larger photosynthetic surface than conifer needles for the same weight of green tissue. These two advantages appear to favor the more rapid growth of alder seedlings under coastal forest conditions.

Nitrogen Fertilizer Boosts Douglas-Fir Growth

In 1964, ammonium nitrate was applied to 1/10-acre plots in a 35-year-old Douglas-fir plantation at rates of 200, 400, and 600 pounds N per acre. This 12-plot study is located on site quality V land in the Wind River Experimental Forest near Carson, Washington. In the four growing seasons since treatment, average height growth of trees on fertilized plots increased 43 to 64 percent and gross basal area growth, 73 to 120 percent over untreated plots. Increased snowbreak and mortality, principally in the lower crown classes, were apparent in stands receiving 400 or more pounds N per acre. In view of these two conflicting trends, highest net basal area increment was obtained with 200 pounds N per acre (probable cost \$30 on an operational basis). The marked and rapid response obtained indicates N fertilization may have high practical value as a silvicultural measure on N-deficient sites.

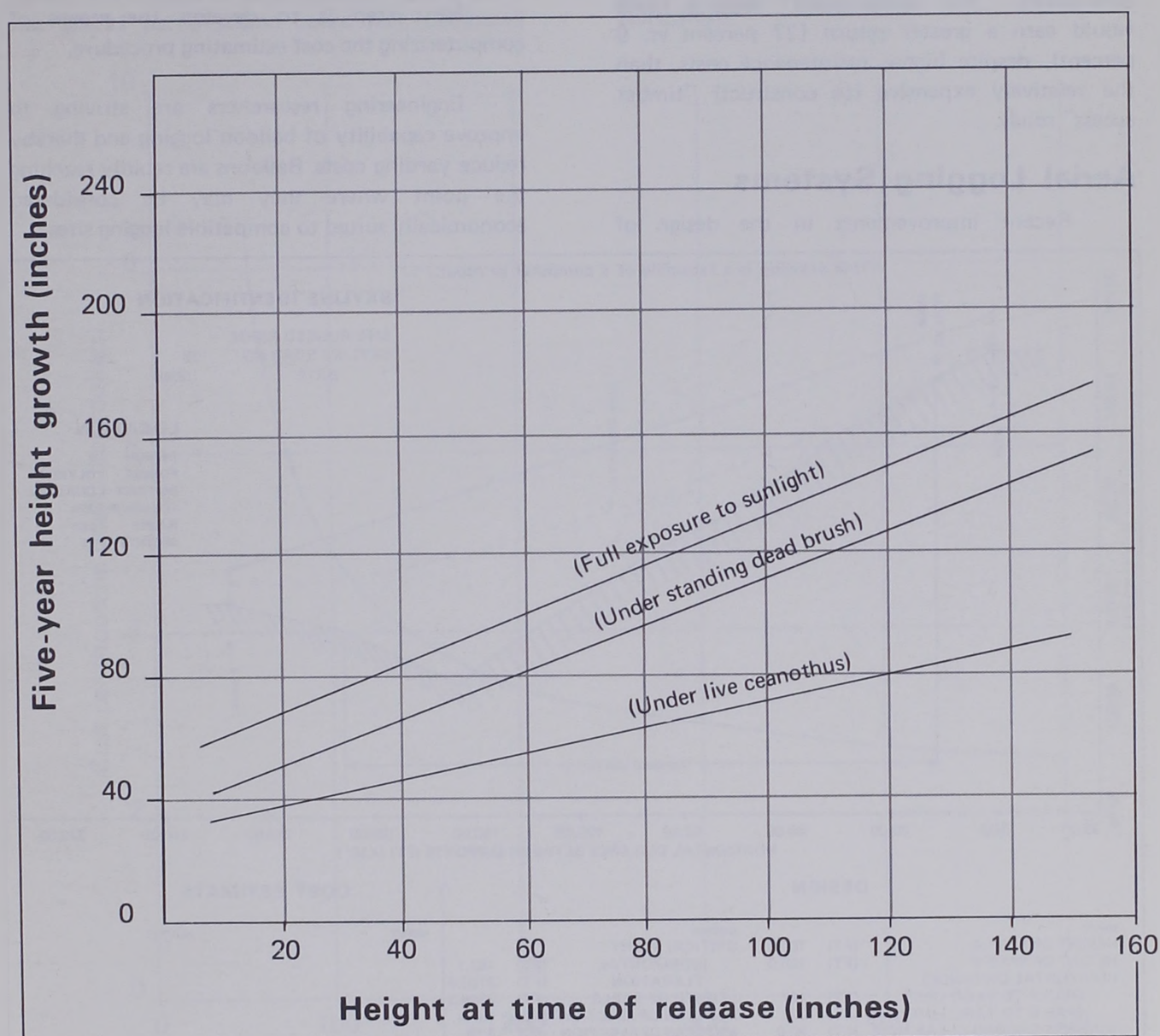


Ceanothus Retards

Douglas-Fir

Releasing young Douglas-firs from an overstory of varnishleaf ceanothus appreciably increased their height growth during a 5-year study in southwestern Oregon. Complete release (by lopping shrubs and killing stumps with herbicide) produced the maximum sustained response. Height growth of completely released trees was almost twice that of trees under live ceanothus. Basal spraying (leaving standing dead brush similar to effects of aerial spraying) also increased height

growth. Some trees were knocked down by falling dead shrubs, but height growth of undamaged trees amid basal-sprayed brush was approximately 1-1/2 times that of similar trees under live ceanothus. Improved height growth of released trees was attributed to increased light and decreased competition for soil moisture during the dry summer season. Although most Douglas-firs under varnishleaf ceanothus will eventually overtop the shrubs and then increase height growth, early release can speed the process by at least 5 or 6 years. Thus, release can be employed to either reduce rotation periods or increase volume yields during fixed rotation periods.



Road Construction Standards

Road construction is a major expense item in managing public forests in the Pacific Northwest region. For example, in the Douglas-fir subregion (west side of Cascades), cost for building the National Forests' permanent timber access road system typically ranges from \$115,000 to \$130,000 per section.

A recent study of roading alternatives for young-growth Douglas-fir disclosed that a forest manager's choice of road standard can greatly influence the profitability of construction investments. For example, where limited traffic is anticipated, "low design-speed" logging roads would earn a greater return (27 percent vs. 9 percent), despite higher maintenance costs, than the relatively expensive (to construct) "timber access" roads.

Aerial Logging Systems

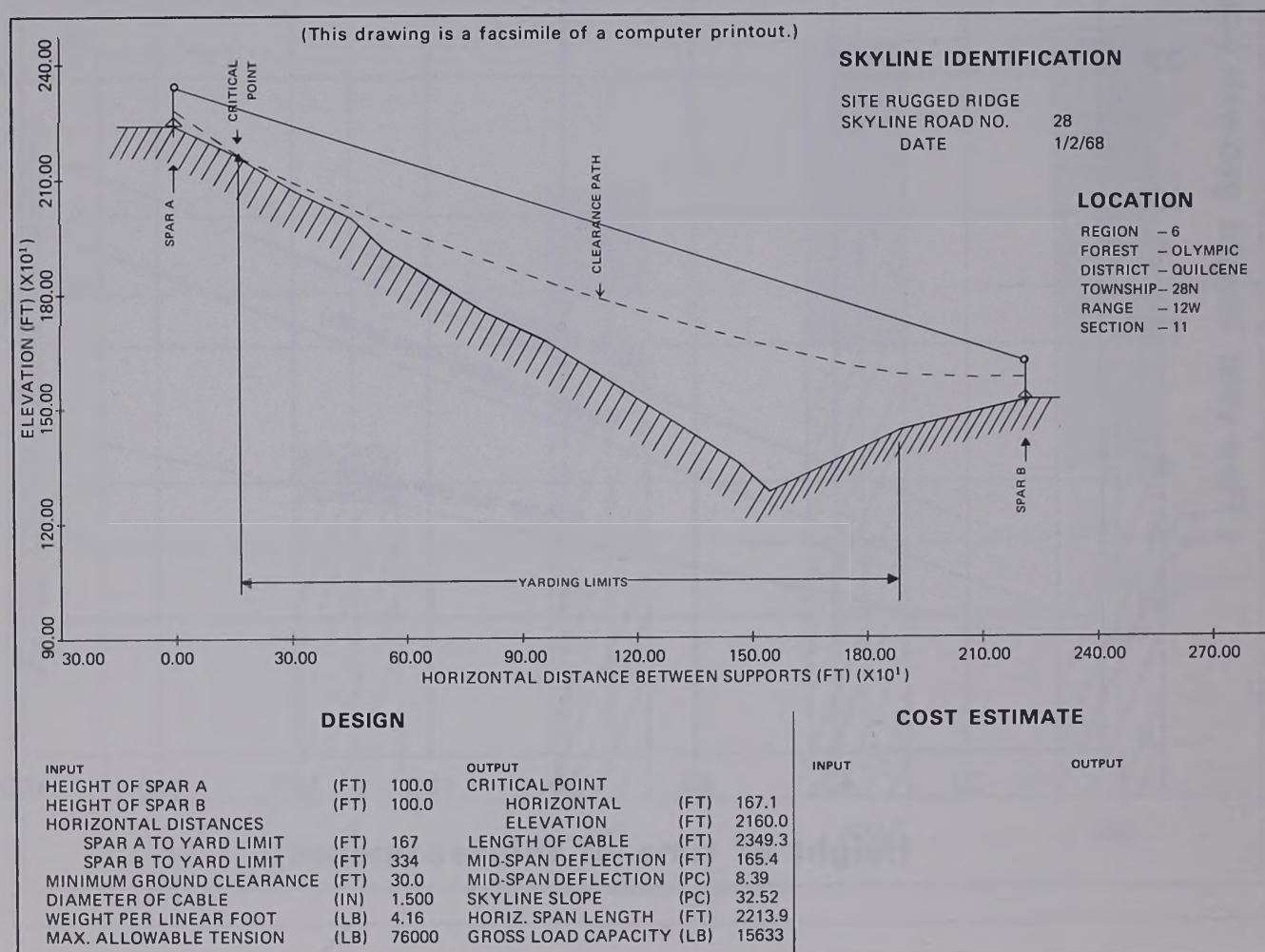
Recent improvements in the design of

interlocking yarders and lightweight carriages will probably result in a substantial increase in the use of skyline cranes and grapple yarding systems.

The Forest Engineering Research Project in Seattle is developing a means of computerizing the layout of economical skyline logging shows. The drawing silhouettes a typical skyline road profile together with the results of the calculations of the gross load capability. The sketch and printout was made by an electronic plotter. It is obtained by digitizing a selected skyline road on a topography map, which in turn is fed into a computer which directs the output of an electronic plotter.

Next step is to develop the means of computerizing the cost-estimating procedure.

Engineering researchers are striving to improve capability of balloon logging and thereby reduce yarding costs. Balloons are rapidly reaching the point where they may be considered economically suited to compatible logging sites.



Marketing

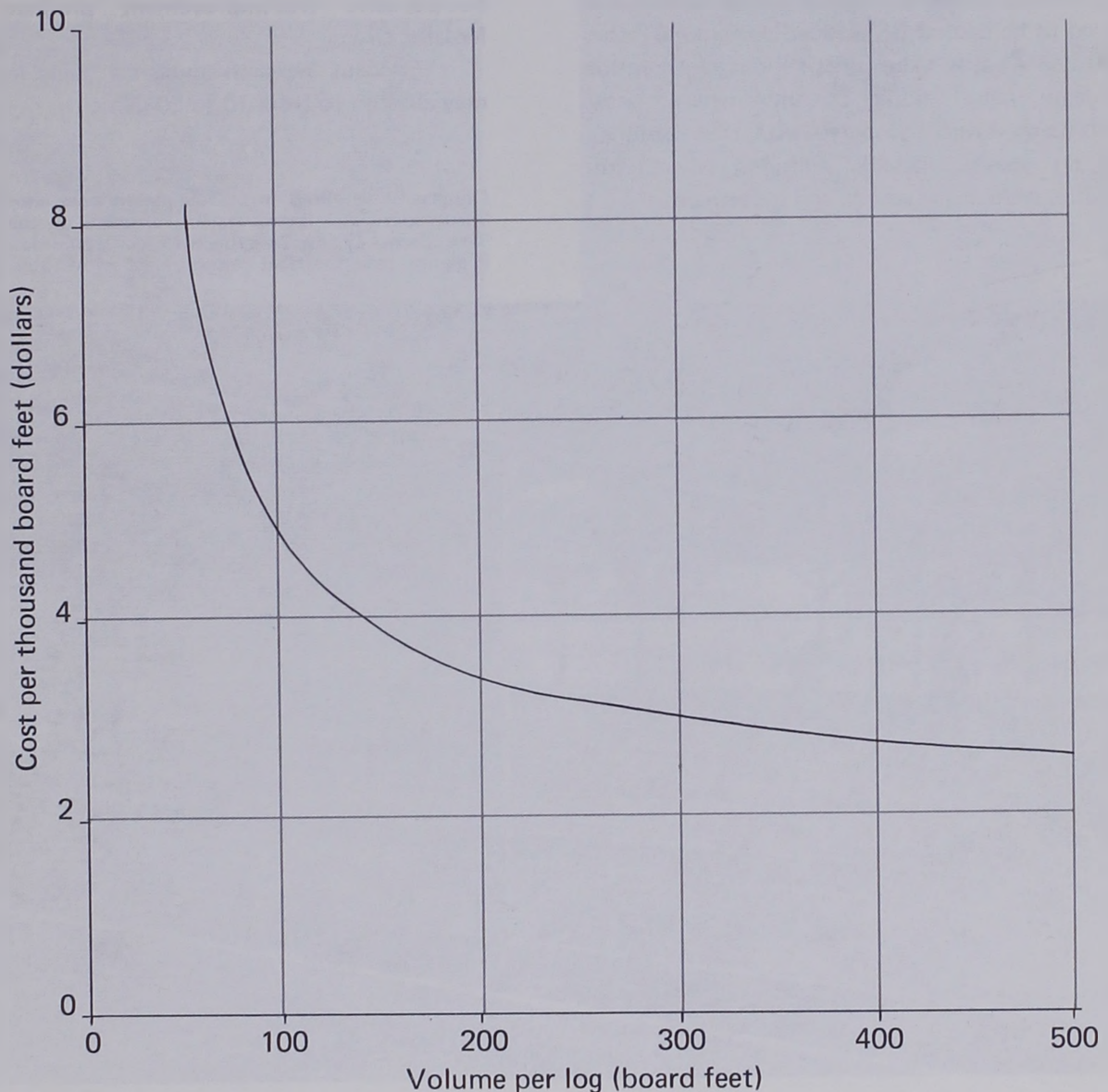
Marketing economics research has been expanded to include Alaska. Information about Alaska's forest resources and forest industries is being gathered in an effort to define forest-product marketing problems which will be included in the marketing economics research program.

Log exports from Oregon and Washington continued to rise, reaching 1.6 billion board feet, Scribner scale, in 1967. This is a 42-percent increase over 1966. Most of these logs went to Japan. The average value at ports of log shipments was \$88.91 per thousand board feet, compared

with \$82.84 in 1966.

Results of research on production rates and costs in commercial thinning of young-growth Douglas-fir were published in U.S. Forest Service Research Paper PNW-41. Typical direct skidding costs with a 4-wheel rubber-tire skidder were found to be \$4.80 per thousand board feet, Scribner scale, for a 100-board-foot log, and nearly twice that or \$8.28 per thousand board feet for a 50-board-foot log (see graph).

Research is now underway into sales arrangements for intermediate cuts and in the structure of the wood-chip market in the Pacific Northwest.



Natural Reforestation in Southeast Alaska

Harvesting of Alaska's western hemlock-Sitka spruce climax timber stands began in 1953 to provide timber for the State's first modern pulpmill. We began a study of natural reforestation the following year on a 700-acre cutting unit on the Maybeso Experimental Forest near Hollis, Prince of Wales Island. Eight years after logging began, the large cutting unit was found to be generally well stocked with a vigorous stand composed of 53 percent western hemlock, 41 percent Sitka spruce, and 6 percent western redcedar and Alaska-cedar. Some areas were overstocked with dense seedling stands. Seed was blown up to one-half mile from uncut timber.

Poorly stocked areas were identified and proved to be caused by seedbed conditions rather than lack of seed. The most serious regeneration problems were along streams where dense salmonberry brush competed with tree seedlings, and on steep, unstable hillsides where tree seedlings were destroyed by soil movement.

Shortcuts to Better Trees

Application of progressive tree improvement, based on the Station's 50-year-old study of Douglas-fir, is well underway. Crown Zellerbach Corporation, in the second year of a pilot program for the 80,000-acre Stamm Tree Farm, sowed seed from 309 parent trees for a progeny test. Late in the year, arrangements were made to extend this program to a total of 310,000 acres of intermingled forest lands in northwest Oregon through cooperation with Crown Zellerbach, Longview Fibre Co., and the State of Oregon. The meshing of these three programs was catalyzed by the Industrial Forestry Association. Several forest-land owners are exploring a second cooperative tree-improvement program near Molalla, Oreg.

Previous research indicates gains in yields may amount to from 10 to 50 percent.

Douglas-fir seedlings from 309 parent trees chosen for a "progressive tree improvement" program on the Stamm Tree Farm, Crown Zellerbach Corp., Vernonia, Oregon. Program calls for field progeny test of all 309 parents.



Upper-Slope Cone Production

A 6-year study of cone production in true fir-mountain hemlock stands shows that a fair-to-good cone crop can be expected on at least one species almost every year. Western white pine and noble fir were the most consistent producers. Engelmann spruce and grand fir also demonstrated a capability for producing large cone crops at frequent intervals. Mountain hemlock was not as prolific as had been thought, perhaps because old cones persist on trees for 2 or 3 years. Poor cone production by Pacific silver fir indicates natural regeneration of this species may require a continuing seed source as in selection or shelterwood cutting. Cone production varied widely among individual trees of the same species.

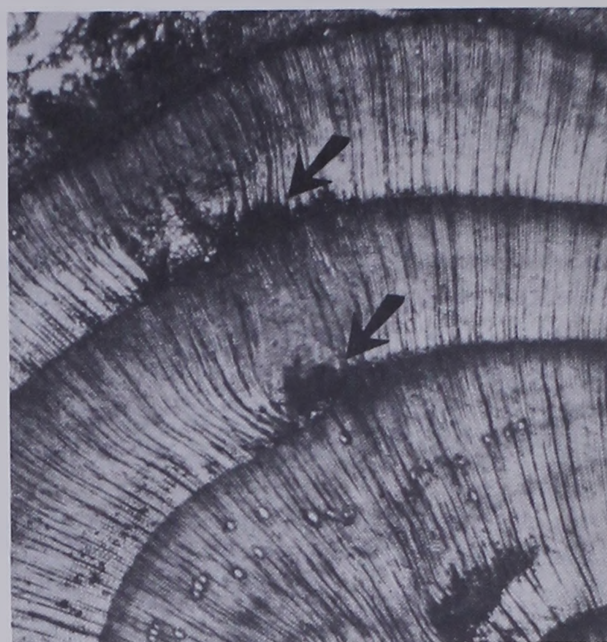


Noble fir—a consistently good cone producer.

Graft Incompatibility

A first solution to graft incompatibility—the number one problem in Douglas-fir seed orchards—was found in 1967. We learned how to positively identify incompatible grafts 15 months after grafting. This technique makes it practical to identify and eliminate highly incompatible clones from future orchards. Seed orchardists from

Oregon and Washington met recently to plan use of this method to screen clones in existing and future seed orchards. Direct solution for even the incompatibles appears practical since clones highly incompatible with most stocks have been found to be compatible with a few juvenile stocks. By rooting cuttings from such stocks, special compatible understocks could be produced for problem clones. Research on this lead is underway.



The characteristic symptom of incompatibility, wound area (arrows), is found only in union zones of incompatible grafts.

Seedling Reserves Highest in Winter

This finding for nursery-grown Douglas-fir seedlings may be surprising to those thinking of winter as a time of inactivity for conifers. It emphasizes one advantage of evergreen foliage—that food reserves, accumulated slowly through late fall and winter, are available for rapid growth in the spring. Lifting nursery-grown seedlings at times when reserves are high, and devising storage methods which maintain these reserves, may be keys to maximizing seedling growth after outplanting. A second important finding—that maximum root activity precedes bud break by several weeks—provides another reason for lifting seedlings early in the spring. Seedlings lifted early can be expected to make peak root growth in the field rather than in the nursery bed.

ANNOTATED LIST OF PUBLICATIONS

1967

THIS IS A LIST OF ALL PUBLICATIONS BY STATION STAFF AND COOPERATORS DURING THE YEAR 1967, INCLUDING PUBLISHED TALKS AND ADDRESSES (FEDERAL, STATE, OR PRIVATE COOPERATORS ARE INDICATED BY AN ASTERISK.) AVAILABLE PUBLICATIONS MAY BE ORDERED BY THE FIVE-DIGIT NUMBER AT THE END OF AUTHOR LINE.

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- ADAMS, THOMAS C. 2 67073
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- *ALEXANDER, ROBERT R., *TACKLE, DAVID, AND 7 67067
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- BINKLEY, VIRGIL W. 3 67123
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ROCKY MOUNTAIN FOREST IND. CONF. PROC. 1967, 3 PP. (UNNUMBERED), COLO. STATE UNIV. (NO COPIES AVAILABLE) DUE TO LOW-VALUE TIMBER, RESTRICTED OPERATING SEASON, AND LOW YIELD PER ACRE, AERIAL LOGGING HAS LIMITED USE IN THE ROCKY MOUNTAINS UNTIL ECONOMIC CONDITIONS CHANGE. BEFORE ANY AERIAL SYSTEM IS BROUGHT INTO THE ROCKIES, A THOROUGH EVALUATION OF ITS CAPABILITY TO YARD LOGS PROFITABLY SHOULD BE MADE.
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PRIMARY MICROBIOLOGICAL SUCCESSION ON A LANDSLIDE OF ALPINE ORIGIN AT MOUNT RAINIER.
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AND TARRANT, ROBERT F.
INFLUENCE OF RED ALDER ON FERTILITY OF A FOREST SOIL--MICROBIAL AND CHEMICAL EFFECTS.
OREG. STATE UNIV. SCH. FOREST., FOREST RES. LAB. RES. BULL. 12, 61 PP., ILLUS. (COPIES AVAILABLE FROM OREGON STATE UNIVERSITY, CORVALLIS, OREG. 97331) MICROBIAL AND CHEMICAL CHARACTERISTICS OF SOIL UNDER STANDS OF ALDER, CONIFER, AND MIXTURES OF BOTH SPECIES WERE DETERMINED AT SEASONAL INTERVALS. TOTAL NITROGEN WAS ALWAYS HIGHER UNDER ALDER AND THE MIXED STAND THAN BENEATH CONIFERS. 'STREPTOMYCES,' MOST PROMINENT UNDER THE MIXED STAND, PRODUCE ANTIBIOTICS WHICH MAY INHIBIT FUNGAL PATHOGENS THAT ATTACK ROOTS OF CONIFERS.
- *BRANNOCK, L. DOUGLAS, AND *FREED, V.H. 6 67126
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- BRUCE, DAVID. 8 67071
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- BRUCE, DAVID. 4 67025
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SOME SELECTED FINDINGS FROM A CAMPER SURVEY MADE ON THE
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PRESENTED, INCLUDING DETAILS ABOUT AGES, FAMILY SIZE,
ECONOMIC POSITION, AND ATTITUDES OF THE PARTICIPANTS IN
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- CAROLIN, V. M., AND THOMPSON, C. G. 3 67017
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OF THE LOOPER FOR ECONOMIC CONTROL. FURTHER TESTS ARE
NEEDED WITH IMPROVED FORMULATION, APPLICATION RATE, AND
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- CHAPPELLE, D. E. 2 67013
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THAT WILL SORT TREES INTO BROAD USE CLASSES AND PROVIDE
GOOD ESTIMATES OF THE VOLUME AND VALUE OF THEIR END
PRODUCTS.
RESEARCH TO IDENTIFY THE IMPORTANT QUALITY CHARACTERIS-
TICS AFFECTING TIMBER VALUE WILL PROVIDE MORE ACCURATE
GRADING SYSTEMS.
- LEVNO, AL, AND ROTHACHER, JACK. 10 67110
INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER LOGGING IN
OLD-GROWTH DOUGLAS-FIR WATERSHEDS.
U.S. FOREST SERV. RES. NOTE PNW-65, 12 PP., ILLUS.
PATCH CLEARCUTS, THE COMMONLY USED LOGGING PATTERN IN
THE DOUGLAS-FIR REGION, RESULTED IN NO SIGNIFICANT
INCREASE IN MAXIMUM WATER TEMPERATURES UNTIL A SLIDE EX-
POSED A SECTION OF STREAMBED TO DIRECT SOLAR RADIATION.
PROGRESSIVE CLEARCUTTING OF A 237-ACRE WATERSHED RESULT-
ED IN INCREASES AFTER 55 PERCENT OF THE DRAINAGE WAS
LOGGED.
- *LI, C. Y., LU, K. C., TRAPPE, J. M., AND 10 67102
BOLLEN, W. B.
EFFECT OF PH AND TEMPERATURE ON GROWTH OF 'PORIA WEIRII' IN
VITRO.
U.S. FOREST SERV. RES. NOTE PNW-66, 6 PP., ILLUS.
GROWTH OF AN ISOLATE, TESTED ON SYNTHETIC MEDIA RANGING
FROM PH 3.0 TO 7.5, INCREASED WITH PH TO AN OPTIMUM AT
6.0. NO GROWTH OCCURRED AT 6.5 OR HIGHER. GROWTH ALSO
INCREASED WITH TEMPERATURE FROM 5 C TO 20 C, ABOVE WHICH
IT DECREASED TO NONE AT 30 DEGREES OR HIGHER.
- *LI, C.Y., LU, K.C., TRAPPE, J.M., AND BOLLEN, W.B. 2 67016
SELECTIVE NITROGEN ASSIMILATION BY 'PORIA WEIRII'.
NATURE (LONDON) 213(5078), P. 814.
THIS ROOT-ROTTING FUNGUS CANNOT ASSIMILATE THE NITRATE
FORM OF NITROGEN, WHEREAS SOIL ORGANISMS THAT INHIBIT
P. WEIRII CAN. A BUILDUP OF SOIL NITROGEN, SUCH AS
OCCURS FROM NITROGEN FIXING BY ALDER NODULES, OFFERS
POTENTIAL BIOLOGICAL CONTROL OF THE DISEASE.
- LUND, H. GYDE. 5 67040
PHOTO TEMPLETS FOR USE WITH MAPS, PHOTO INDEXES, AND
MOSAICS.
J. FOREST. 65, P. 338, ILLUS. (NO COPIES AVAILABLE.)
BRIEFLY DISCUSSES THE USES OF PHOTO TEMPLETS AND HOW TO
MAKE THEM. GIVES A FORMULA FOR COMPUTING TEMPLET SIZE,
AND PRESENTS A TABLE OF THE TEMPLET SIZES MOST COMMONLY
NEEDED.
- LUND, H. GYDE, FAHNESTOCK, GEORGE R., AND 7 67072
NEAR, JOHN F.
AERIAL PHOTO INTERPRETATION OF UNDERSTORIES IN TWO OREGON
OAK STANDS.
U.S. FOREST SERV. RES. NOTE PNW-58, 6 PP., ILLUS.
NATURAL-COLOR AERIAL PHOTOGRAPHY PROVED SUPERIOR TO
FALSE-COLOR, AND A SCALE OF 1 TO 3,500 TO ONE OF
1 TO 2,000, FOR MAPPING HEIGHT AND DENSITY OF UNDERSTORY
VEGETATION IN OREGON OAK STANDS. FURTHER RESEARCH ON
PHOTOGRAPHIC AND INTERPRETIVE TECHNIQUES IS WARRANTED.
- LYSONS, HILTON H., AND MANN, CHARLES N. 4 67037
SINGLE-SPAN RUNNING SKYLINES.
U.S. FOREST SERV. RES. NOTE PNW-52, 7 PP., ILLUS.
A SKYLINE ARRANGEMENT, CALLED A 'RUNNING SKYLINE,' IN
WHICH THE MAIN AND HAULBACK LINES ARE TENSIONED TOGETHER
TO SUPPORT A LOAD, IS PRESENTED WITH A PROCEDURE FOR
CALCULATING PAYLOAD CAPABILITY.
- LYSONS, HILTON H., AND MANN, CHARLES N. 3 67020
SKYLINE TENSION AND DEFLECTION HANDBOOK.
U.S. FOREST SERV. RES. PAP. PNW-39, 41 PP., ILLUS.
GIVES PROCEDURES FOR CALCULATING THE TENSIONS, DEFLEC-
TIONS, AND LENGTHS OF SINGLE AND MULTISPAN SKYLINES AS
REQUIRED FOR THEIR EFFICIENT USE. IT IS AN EXPANSION OF
THE 'SKYLINE LOGGING HANDBOOK ON WIRE ROPE TENSIONS AND
DEFLECTIONS,' PUBLISHED IN 1965.

- *MCKIMMY, M. D. 12 66105
A VARIATION AND HERITABILITY STUDY OF WOOD SPECIFIC GRAVITY
IN 46-YEAR-OLD DOUGLAS-FIR FROM KNOWN SEED SOURCES.
TAPPI 49(12), 542-549, ILLUS.
THIS STUDY ANALYZED CAUSES OF VARIATION IN SPECIFIC
GRAVITY FOUND IN DOUGLAS-FIR TREES SAMPLED, EVALUATED
GENETIC AND ENVIRONMENTAL EFFECTS ON SPECIFIC GRAVITY
FOUND IN THE DOUGLAS-FIR TREES SAMPLED, COMPARED VARIATION
IN SPECIFIC GRAVITY OF JUVENILE WOOD AND MATURE
WOOD, ESTABLISHED THE HERITABILITY OF SPECIFIC GRAVITY
IN THE PLANTATIONS STUDIED.
- MARTIGNONI, MAURO E. 6 67061
SEPARATION OF TWO TYPES OF VIRAL INCLUSION BODIES BY
ISOPYCNIC CENTRIFUGATION.
J. VIROL. 1, PP. 646-647, ILLUS.
A SUCROSE DENSITY GRADIENT PROCEDURE WAS USED TO SEPA-
RATE TWO TYPES OF VIRAL INCLUSION BODIES FROM DISEASED
LARVAE OF THE LEPIDOPTERAN 'HEMEROCAMPA PSEUDOTSUGATA.'
NUCLEAR POLYHEDROSIS VIRUS INCLUSIONS CAN BE COLLECTED
IN THE LAYER BETWEEN SOLUTIONS OF SUCROSE OF 700 AND
680 MG/ML. CYTOPLASMIC POLYHEDROSIS VIRUS INCLUSIONS
ARE DRIVEN TO A LAYER BETWEEN SOLUTIONS OF SUCROSE OF
750 AND 730 MG/ML, IN A MAXIMAL GRAVITY FIELD OF
112,000 X 'G'. THE FRACTIONATION PROCEDURE PRODUCES
HIGHLY PURIFIED SUSPENSIONS OF INCLUSION BODIES. THE
EFFICIENCY OF THIS PROCEDURE WAS DEMONSTRATED BY IN-
FECTIVITY TESTS.
- MARTIGNONI, MAURO E., AND MILSTEAD, JAMES E. 3 67018
GLUTAMATE-ASPARTATE TRANSAMINASE ACTIVITY IN THE BLOOD
PLASMA OF AN INSECT DURING THE COURSE OF TWO VIRAL DISEASES.
ANN. ENTOMOL. SOC. AMER. 60, PP. 428-431, ILLUS.
IN LARVAE OF THE NOCTUID, PERIDROMA SAUCIA, THE ACTIVITY
OF GLUTAMATE-ASPARTATE TRANSAMINASE WAS SIGNIFICANTLY
ELEVATED AT THE FOURTH AND SUBSEQUENT DAYS AFTER INOCU-
LATION WITH NUCLEOPOLYHEDROSIS VIRUS. THE ELEVATION WAS
LESS MARKED DURING THE COURSE OF GRANULOSIS. THESE DIF-
FERENCES IN HYPERENZYMEMIA APPEAR TO BE THE RESULT OF
DISSIMILAR CYTOTOXIC ACTIVITIES OF THE TWO VIRUSES.
- MEAGHER, GEORGE S. 6 67057
SILVICULTURE IN THE DOUGLAS-FIR REGION -- IN RETROSPECT.
SOC. AMER. FOREST. PROC. (1966), PP. 90-93.
A BRIEF REVIEW OF THE HISTORY OF FOREST PRACTICE IN THE
DOUGLAS-FIR REGION FROM THE START OF ORGANIZED FIRE
PROTECTION FOLLOWING THE YACOLT FIRE IN 1902 TO PRESENT-
DAY SOPHISTICATED CULTURAL AND BREEDING PRACTICES THAT
PROMISE TO BOOST CURRENT OR POTENTIAL WOOD YIELDS.
- *MILSTEAD, JAMES E., MARTIGNONI, MAURO E., AND 5 67042
*JOHNSON, MARTHA A.
DEVELOPMENTAL CHANGES IN WEIGHT AND HEMOLYMPH TOTAL SOLIDS
IN THE SIXTH INSTAR OF 'PERIDROMA SAUCIA' (LEPIDOPTERA,
NOCTUIDAE).
ANN. ENTOMOL. SOC. AMER. 60, PP. 702-705.
A STUDY OF SPRING, SUMMER, AND WINTER GENERATIONS OF THE
VARIEGATED CUTWORM SHOWS SEASONAL VARIATIONS IN THE
WEIGHT INCREASE PATTERN OF LAST-INSTAR LARVAE. ALSO THE
LEVEL OF HEMOLYMPH TOTAL SOLIDS SHOWS SEASONAL VARI-
ATIONS BETWEEN GROUPS OF LARVAE OF IDENTICAL AGE AND SEX.
HOWEVER, VARIATIONS IN TOTAL SOLIDS ARE LESS STRIKING
THAN THOSE IN LARVAL WEIGHT. CAUSES OF THESE VARIATIONS
ARE DISCUSSED.
- MITCHELL, RUSSEL G. 9 67080
ABNORMAL RAY TISSUE IN THREE TRUE FIRS INFESTED BY THE
BALSAM WOOLLY APHID.
FOREST SCI. 13, PP. 327-332, ILLUS.
BALSAM WOOLLY APHID INFESTATIONS CAUSE ABNORMAL
PROLIFERATION OF RAY TISSUE IN THE WOOD OF SOME HOSTS.
VOLUME OF RAY TISSUE IN INFESTED GRAND, SUBALPINE, AND
PACIFIC SILVER FIR WAS FOUND 150 TO 180 PERCENT GREATER
THAN NORMAL. THIS REFLECTS A LARGER NUMBER OF RAYS AND
INCREASED RAY HEIGHT AND WIDTH.
- MITCHELL, RUSSEL G. 1 67002
TRANSLOCATION OF DYE IN GRAND AND SUBALPINE FIRS
INFESTED BY THE BALSAM WOOLLY APHID.
U.S. FOREST SERV. RES. NOTE PNW-46, 17 PP., ILLUS.
STEM-INFESTING POPULATIONS OF BALSAM WOOLLY APHID ON
GRAND AND SUBALPINE FIR STIMULATE PRODUCTION OF ABNOR-
MALLY DENSE, REDDISH WOOD. WHEN DYE WAS USED TO TRACE
WATER-CONDUCTION IN THESE TREES, IT WAS FOUND THAT SUCH
WOOD MATERIALLY ALTERS THE NORMAL WATER-CONDUCTING
PATTERNS.
- MITCHELL, R. G., AND WRIGHT, K. H. 2 67003
FOREIGN PREDATOR INTRODUCTIONS FOR CONTROL OF THE BALSAM
WOOLLY APHID IN THE PACIFIC NORTHWEST.
J. ECON. ENTOMOL. 60, PP. 140-147, ILLUS.
FIVE OF 23 SPECIES OF EUROPEAN PREDATORS INTRODUCED
SINCE 1957 HAVE BECOME ESTABLISHED BUT, FOR VARIOUS
REASONS, HAVE NOT REDUCED APHID POPULATIONS ENOUGH
TO PREVENT TREE KILLING.
- NEAL, J. L., JR., LU, K. C., BOLLEN, W. B., AND 7 67060
TRAPPE, J. M.
TWO SIMPLE, TIME-SAVING TECHNIQUES FOR STUDIES OF SOIL
MICRO-ORGANISMS.
U.S. FOREST SERV. RES. NOTE PNW-57, 3 PP., ILLUS.
METHODS ARE DESCRIBED FOR UNIFORM INOCULATION OF AN AGAR
SURFACE IN A PETRI PLATE WITH A DILUTED SOIL SUSPENSION
AND FOR TRANSFER OF RESULTING COLONIES TO STERILE,
BROTH-CONTAINING CULTURE TUBES.
- *NEAL, J. L., JR., TRAPPE, J. M., LU, K. C., 3 67034
AND BOLLEN, W. B.
STERILIZATION OF RED ALDER SEEDCOATS WITH HYDROGEN PEROXIDE.
FOREST SCI. 13, PP. 104-105.
SEEDCOATS OF RED ALDER ('ALNUS RUBRA' BONG.) WERE STER-
ILIZED BY A 10-MINUTE SOAK IN REAGENT GRADE, 30 PERCENT
HYDROGEN PEROXIDE. SEED THUS TREATED GERMINATED WELL
AND PRODUCED VISIBLY NORMAL SEEDLINGS.
- NELSON, EARL E. 3 67038
FACTORS AFFECTING SURVIVAL OF PORIA WEIRII IN SMALL
BURIED CUBES OF DOUGLAS-FIR HEARTWOOD.
FOREST SCI. 13, PP. 78-84, ILLUS.
'PORIA WEIRII' IN 2-INCH CUBES SURVIVED UP TO 5 YEARS AT
24-INCHES DEPTH. SURVIVAL IS POSITIVELY ASSOCIATED WITH
ZONE LINES AND NEGATIVELY WITH MICROBIAL ACTIVITY.
- *NORRIS, L. A. 12 67136
CHEMICAL BRUSH CONTROL AND HERBICIDE RESIDUES IN THE FOREST
ENVIRONMENT.
OREG. STATE UNIV. HERBICIDES AND VEGETATION MANAGE. SYMP.
PROC. 1967, PP. 103-123, ILLUS.
THE MAXIMUM CONCENTRATION OF HERBICIDE IN STREAMS WHICH
FLOW BY OR THROUGH TREATED AREAS IS A FUNCTION OF THE
PROPORTION OF THE WATERSHED TREATED, THE AMOUNT OF LIVE
STREAM INCLUDED IN THE UNIT, THE RATIO OF THE SURFACE
AREA OF THE STREAM TO ITS VOLUME, AND THE DEGREE TO
WHICH BRUSH OVERHANGING THE STREAM INTERCEPTS SPRAY
MATERIALS. STREAM CONTAMINATION CAN BE HELD TO AN
ABSOLUTE MINIMUM BY RECOGNIZING AND AVOIDING SITUATIONS
WHICH LEAD TO DIRECT APPLICATIONS TO STREAMS OR SURFACE
WATER.
- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 6 67053
A PIONEER SEARCH FOR BETTER KINDS OF TREES FOR THE NORTH-
WEST, WIND RIVER ARBORETUM.
16 PP. (UNNUMBERED), ILLUS.
A GUIDE BOOK TO KEY VIEWPOINTS, SUMMARIZING THE RESULTS
OF 50 YEARS OF TESTING SUITABILITY OF EXOTIC TREES FOR
THIS HABITAT.
- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 3 67019
AN ANNOTATED LIST OF PUBLICATIONS OF THE PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION FOR THE YEAR 1966.
19 PP.
- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 4 67030
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36 PP., ILLUS.
- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 6 67047
COOPERATIVE FEDERAL AND STATE RESEARCH AT THE ANIMAL PROBLEMS
LABORATORY.
15 PP. (UNNUMBERED), ILLUS.
DESCRIBES THE RESEARCH TO PROTECT FOREST CROPS FROM
ANIMAL DAMAGE AS CONDUCTED AT THE ANIMAL PROBLEMS LABOR-
ATORY NEAR OLYMPIA, WASH., BY THE PACIFIC NORTHWEST
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U.S. DEPARTMENT OF AGRICULTURE, BUREAU OF SPORT FISHERIES
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SOURCES, STATE OF WASHINGTON, AND GAME MANAGEMENT
DIVISION, DEPARTMENT OF GAME, STATE OF WASHINGTON.
- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 3 67091
LIST OF AVAILABLE PUBLICATIONS--FIRST LIST FOR 1967.
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- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 7 67093
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- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 9 67094
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LIST OF AVAILABLE PUBLICATIONS--FIFTH LIST FOR 1967.
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- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 12 67121
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1 P., WITH ANNOTATIONS.
- PACIFIC NORTHWEST FOREST AND RANGE EXP. STA. 11 67120
WOOD COMPONENTS FOR PREENGINEERED BUILDING SYSTEMS.
16 PP., ILLUS.
A REPORT OF HOW THE METAL BUILDING INDUSTRY OPERATES IN THE PACIFIC NORTHWEST BASED ON DISCUSSIONS WITH 10 CONTRACTOR-DISTRIBUTORS OF PREENGINEERED METAL BUILDING SYSTEMS.
- PATRIC, J. H. 6 67111
EVAPORATION AND TRANSPIRATION.
AMER. GEOPHYS. UNION TRANS. 48(2), 701-707.
ONE HUNDRED SELECTED REFERENCES PUBLISHED DURING 1963-66 ARE INCORPORATED INTO A QUADRENNIAL SYNOPSIS OF U.S. RESEARCH ON EVAPORATION. TOPICS INCLUDE ESTIMATING EVAPOTRANSPIRATION, EVAPORATION FROM PANS AND LAKES, FROM BARE, CRUPPED, AND FORESTED LANDS, AND FROM TRANSPIRATION, EVAPORATION SUPPRESSION, AND INSTRUMENTATION.
- PATRIC, J. H. 7 67074
FROST DEPTH IN FOREST SOILS NEAR JUNEAU, ALASKA.
U.S. FOREST SERV. RES. NOTE PNW-60, 7 PP., ILLUS.
FROST PENETRATION AND SNOW DEPTH WERE MEASURED ON A LOGGED AREA 5 MILES NORTH OF JUNEAU, ALASKA. MAXIMUM FROST PENETRATION WAS 15, 18, AND MORE THAN 20 INCHES ON FORESTED, CLEARCUT, AND BARE SOILS, RESPECTIVELY. INSULATION BY THE FOREST CANOPY, LITTER, AND SNOW RETARDED BOTH FREEZING AND THAWING. THE RESULTS SUBSTANTIALLY AGREE WITH FROST OBSERVATIONS FROM OTHER FORESTED REGIONS.
- PHARIS, RICHARD P. 12 67128
SEASONAL FLUCTUATION IN THE FOLIAGE-MOISTURE CONTENT OF WELL-WATERED CONIFERS.
BOT. GAZ. 128, PP. 179-185, ILLUS.
RESULTS OF THIS STUDY ALLOW SPECULATION INTO THE PROCESSES CONTROLLING WATER CONTENT OF LEAVES UNDER LOW SOIL-MOISTURE STRESS. ALTHOUGH SOME SEASONAL CHANGES IN FOLIAGE-MOISTURE CONTENT MAY BE CAUSED DIRECTLY BY ENVIRONMENTAL CHANGES, OTHERS ARE PROBABLY MORE CLOSELY ALLIED WITH METABOLIC OR GROWTH CHANGES WITHIN THE PLANT. THE LATTER MAY ACCOMPANY CHANGES IN THE ENVIRONMENT.
- RADWAN, M. A. 9 67078
TRANSLOCATION AND METABOLISM OF C14-LABELED TETRAMINE BY DOUGLAS-FIR, ORCHARD GRASS, AND BLACKBERRY.
FOREST SCI. 13, PP. 265-273, ILLUS.
ABSORPTION, TRANSLOCATION, AND METABOLISM OF TETRAMINE-C14 WERE INVESTIGATED IN THREE PLANT SPECIES. CONTRARY TO EARLIER FINDINGS BY OTHERS USING BIOASSAY METHODS, TETRAMINE PROVED TO BE NONSYSTEMIC AND SUBJECT TO DEGRADATION IN PLANTS. AT PRESENT, THEREFORE, USE OF TETRAMINE TO PROTECT TREE SEEDLINGS FROM ANIMALS DOES NOT LOOK PROMISING.
- RADWAN, M. A., *DODGE, W. E., AND *WARD, H. S. 11 67138
EFFECT OF STORAGE ON SUBSEQUENT GROWTH AND REPELLENCY OF DOUGLAS-FIR SEEDLINGS SPRAYED WITH TMTD.
TREE PLANTERS' NOTES 18(4), PP. 1-4.
STORAGE AFFECTED GROWTH, SURVIVAL, AND REPELLENCY OF TMTD-TREATED DOUGLAS-FIR SEEDLINGS. SEEDLINGS SHOULD BE SPRAYED WITH TMTD JUST BEFORE OUTPLANTING. IF OUT-PLANTING IS DELAYED AFTER SPRAYING, SEEDLINGS SHOULD BE LEFT IN THE NURSERY BEDS AND NOT STORED.
- REUKEMA, DONALD L. 5 67024
THE YIELD AND DENSITY ASPECT--DOES DENSE SPACING REALLY PRODUCE THE MOST VOLUME.
IN 'WESTERN REFORESTATION.' WEST. FOREST. AND CONSERV. ASS. WEST. REFOREST. COORDINATING COMM. PROC. 1966, PP. 23-26.
ANALYZES APPARENT CONFLICTS REGARDING THE EFFECT OF STAND DENSITY ON TOTAL CUBIC VOLUME PRODUCTION. INDICATIONS ARE THAT PLANTING OR PRECOMMERCIALY THINNING TREES TO UNIFORM, FAIRLY WIDE SPACING WILL RESULT IN STANDS WHICH YIELD MORE TOTAL VOLUME THAN UNMANAGED OR DENSELY SPACED STANDS.
- RICKARD, WESLEY M., HUGHES, JAY M., AND NEWPORT, CARL A. 11 67140
ECONOMIC EVALUATION AND CHOICE IN OLD-GROWTH DOUGLAS-FIR LANDSCAPE MANAGEMENT.
U.S. FOREST SERV. RES. PAP. PNW-49, 33 PP., ILLUS.
PRESENT NET WORTHS FOR SEVERAL TIMBER CUTTING PRACTICES OVER A RANGE OF OLD-GROWTH DOUGLAS-FIR STAND CONDITIONS ARE PRESENTED. THESE PRACTICES ARE VIEWED AS POSSIBLE TREATMENT ALTERNATIVES WHERE ESTHETIC YIELD IS ALSO IMPORTANT.

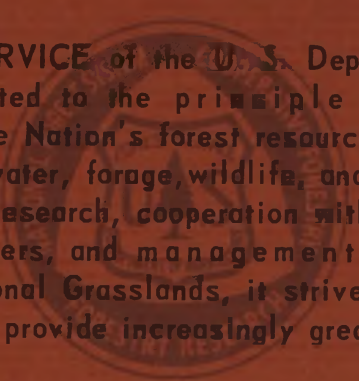
TWO PROCESSES ARE PROPOSED FOR INSTANCES WHERE MANAGEMENT DECISIONS REQUIRE SIMULTANEOUS CONSIDERATION OF DOLLAR AND NONDOLLAR CONSEQUENCES OF ALTERNATIVE CUTTING PRACTICES. (1) THE SIMPLE BETTERNESS METHOD AND (2) THE COMPENSATION TECHNIQUE.
- ROSS, R. H. (N.), AND BERNOT, H. W. 2 67012
INCREASED WATER FROM FORESTS.
WASH. FARMER 92(4), P. 24, ILLUS. (ALSO, OREG. FARMER 90(4), PP. 12-13, ILLUS., AND IDAHO FARMER 85(4), PP. 28-29, ILLUS.) (NO COPIES AVAILABLE)
DURING THE 1965-66 WINTER, SNOWPACKS WERE HEAVIER IN AREAS LOGGED BY THREE METHODS THAN IN UNDISTURBED FOREST. THE GREATEST INCREASE IN WATER CONTENT WAS ON A CLEARCUT BLOCK. SNOWPACKS IN ALTERNATE CLEARCUT AND UNLOGGED STRIPS AND IN SELECTIVELY LOGGED STANDS WERE SIMILAR BUT INTERMEDIATE TO THE LARGE CLEARCUTS AND UNCUT.
- ROTHACHER, JACK, DYRNES, C.T., AND FREDRICKSEN, RICHARD L. 5 67099
HYDROLOGIC AND RELATED CHARACTERISTICS OF THREE SMALL WATERSHEDS IN THE OREGON CASCADES.
PACIFIC NORTHWEST FOREST AND RANGE EXP. STA., 54 PP., ILLUS.
TRAPEZOIDAL FLUMES AND OTHER INSTRUMENTATION WERE USED TO GATHER DATA PRELIMINARY TO A STUDY OF THE EFFECT OF TIMBER HARVESTING AND ROAD CONSTRUCTION ON YIELD, TIMING, AND QUALITY OF STREAMFLOW FROM THREE TRIBUTARY WATERSHEDS IN THE MCKENZIE DRAINAGE OF WESTERN OREGON. DURING THE CALIBRATION PERIOD WHEN THE DENSE DOUGLAS-FIR FORESTS REMAINED UNDISTURBED, DATA WAS COLLECTED WHICH DESCRIBED THE RELATIONSHIP OF GEOLOGY, SOILS, VEGETATION, AND CLIMATE TO STREAMFLOW. THIS REPORT SUMMARIZES THE CHARACTERISTICS OF THESE MIDELEVATION WATERSHEDS ON THE WESTERN SLOPES OF THE CASCADE RANGE.
- ROTHACHER, JACK, AND MINER, NORMAN. 12 66103
ACCURACY OF MEASUREMENT OF RUNOFF FROM EXPERIMENTAL WATERSHEDS.
INT. SYMP. FOREST HYDROL., NAT. SCI. FOUND. ADVANCED SCI. SEMINAR PROC. 1965, PP. 705-713.
ERRORS IN MEASUREMENT OF STREAMFLOW VARY WITH THE DESIGN OF THE CONTROL SECTION, TYPE OF RECORDER, AND MEASUREMENTS TO OBTAIN RATING TABLES. MINIMUM ERROR OBTAINABLE UNDER FIELD CONDITIONS IS ABOUT 3 TO 5 PERCENT.
- RUTH, ROBERT H. 2 67011
FIRST SEASON GROWTH OF ALNUS RUBRA SEEDLINGS IN THE SHADE. (ABSTR.)
NORTHWEST SCI. 41, P. 60. (NO COPIES AVAILABLE)
- RUTH, ROBERT H. 4 67032
SILVICULTURAL EFFECTS OF SKYLINE CRANE AND HIGH-LEAD YARDING.
J. FOREST. 65, PP. 251-255, ILLUS.
SILVICULTURAL EFFECTS OF SKYLINE CRANE YARDING WERE SIMILAR TO CONVENTIONAL HIGH-LEAD YARDING WHEN MEASURED IN TERMS OF SOIL DISTURBANCE AND DAMAGE TO TREE SEEDLINGS AND PLANT COVER. THE MAIN ADVANTAGE OF THE SKYLINE CRANE SYSTEM APPEARS TO BE ITS EFFECTIVENESS IN YARDING LOGS FROM STEEP SLOPES WITH MINIMUM ROAD CONSTRUCTION.
- SASSAMAN, ROBERT W., AND CHAPPELLE, DANIEL E. 9 67084
A COMPUTER PROGRAM FOR CALCULATING ALLOWABLE CUT USING AREA REGULATION AND A COMPARISON WITH THE ARVOL METHOD.
U.S. FOREST SERV. RES. NOTE PNW-63, 7 PP., ILLUS.
DESCRIBES THE AREA COMPUTER PROGRAM WHICH CALCULATES ALLOWABLE CUT USING AREA REGULATION. THE AREA REGULATION METHOD IS COMPARED WITH THE ARVOL METHOD (VOLUME REGULATION). THE SCHEDULING METHOD COMMONLY USED IN OLD-GROWTH DOUGLAS-FIR STANDS IN THE PACIFIC NORTHWEST. RESULTS OF A SAMPLE PROBLEM PROCESSED BY BOTH METHODS ARE DISCUSSED.
- SCHALLAU, CON H. 2 67005
AN ANALYSIS OF TWO LOGGING ROAD STANDARDS FOR BLM'S TILLAMOOK PROJECT.
U.S. FOREST SERV. RES. NOTE PNW-48, 5 PP.
WHERE LIMITED TRAFFIC IS ANTICIPATED, LOW DESIGN-SPEED LOGGING ROADS ARE MORE FEASIBLE THAN THE RELATIVELY EXPENSIVE TIMBER ACCESS ROADS. DESPITE HIGHER MAINTENANCE CHARGES, THE INTERNAL RATE OF RETURN TO AN INVESTMENT IN THE FORMER KIND OF ROAD WAS GREATER THAN THE RATE EARNED BY TIMBER ACCESS ROADS--27 PERCENT AS COMPARED TO 9 PERCENT.
- SILEN, ROY R. 12 67117
EARLIER FORECASTING OF DOUGLAS-FIR CONE CROP USING MALE BUDS.
J. FOREST. 65, PP. 888-892, ILLUS.
FORECASTING CONE CROPS BECOMES POSSIBLE IN JULY, 14 MONTHS AHEAD OF SEEDFALL, BECAUSE COUNTS OF MALE BUDS CORRELATE WELL WITH FALL COUNTS OF FEMALE BUDS. THE MANY POTENTIAL FLORAL BUDS INFLUENCE ACCURACY OF COUNTS BEFORE JULY.
- SKOVLIN, JON M. 4 67070
FLUCTUATIONS IN FORAGE QUALITY ON SUMMER RANGE IN THE BLUE MOUNTAINS.
U.S. FOREST SERV. RES. PAP. PNW-44, 20 PP., ILLUS.
FORAGE QUALITY DECLINE WAS SIMILAR TO THAT REPORTED FOR THE SAME SPECIES IN OTHER MOUNTAINOUS REGIONS. YEAR-TO-

- YEAR VARIATION IN FORAGE QUALITY WAS INTERPRETED IN LIGHT OF PLANT DEVELOPMENT, DATES OF PHENOLOGICAL EVENTS, CURING CONDITIONS, AND SECONDARY FALL GROWTH AS INFLUENCED BY PRECIPITATION, TEMPERATURE, AND TIME OF REGROWTH.
- SORENSEN, FRANK. 7 67088
LINKAGE BETWEEN MARKER GENES AND EMBRYONIC LETHAL FACTORS MAY CAUSE DISTURBED SEGREGATION RATIOS.
SILVAE GENETICA 16, PP. 132-134, ILLUS.
LINKAGE OF MARKER GENES WITH LETHAL GENES DURING EMBRYO DEVELOPMENT IS ONE OF THE SEVERAL FACTORS WHICH MAY CAUSE DISTURBED SEGREGATION RATIOS IN FAMILIES OF ABERRANT SEEDLINGS. DATA FROM INBREEDING STUDIES ARE USED IN AN EXAMPLE ESTIMATING THE FREQUENCY OF SUCH LINKAGE IN DOUGLAS-FIR.
- SORENSEN, FRANK. 12 67124
TWO-YEAR RESULTS OF A WEST-EAST TRANSECT-PROVENANCE TEST OF DOUGLAS-FIR IN OREGON.
U.S. FOREST SERV. RES. NOTE PNW-72, 8 PP.
SEED FROM EIGHT SOURCES OF DOUGLAS-FIR ALONG A WEST-EAST TRANSECT ACROSS OREGON WERE GROWN THROUGH 2 YEARS OF AGE IN A NURSERY BED NEAR CORVALLIS, OREGON. BASED ON HEIGHT GROWTH AND DATE OF 1ST-YEAR BUD SET, SOURCES CAN BE SEPARATED INTO THREE GROUPS WITH CONSIDERABLE SIMILARITY WITHIN GROUPS AND STRIKING DIFFERENCES BETWEEN THEM.
- STEIN, WILLIAM I. 5 67022
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COVERAGE INCLUDES MOST REFERENCES PERTAINING TO WESTERN SPECIES AND SELECTED OTHER REFERENCES HAVING GENERAL APPLICABILITY.
- *STEINHAUS, EDWARD A., AND MARTIGNONI, MAURO E. 10 67100
AN ABRIDGED GLOSSARY OF TERMS USED IN INVERTEBRATE PATHOLOGY.
PACIFIC NORTHWEST FOREST AND RANGE EXP. STA., 22 PP.
- SWANSTON, DOUGLAS N. 9 67096
DEBRIS AVALANCHING IN THIN SOILS DERIVED FROM BEDROCK.
U.S. FOREST SERV. RES. NOTE PNW-64, 7 PP., ILLUS.
THIS PAPER PRESENTS OBSERVATIONS ON THE OCCURRENCE OF DEBRIS AVALANCHING IN THIN, BEDROCK-DERIVED SOILS IN SOUTHEAST PANHANDLE ALASKA WITH A DESCRIPTION OF THE PROBABLE PROCESS AND CAUSES OF FAILURE.
- SWANSTON, DOUGLAS N. 11 67115
SOIL-WATER PIEZOMETRY IN A SOUTHEAST ALASKA LANDSLIDE AREA.
U.S. FOREST SERV. RES. NOTE PNW-68, 17 PP., ILLUS.
HEIGHT OF SOIL-WATER PIEZOMETRIC SURFACE IN SATURATED GLACIAL TILL SOILS ON STEEP SLOPES VARIES DIRECTLY WITH RAINFALL AND INVERSELY WITH ELEVATION AND LATERAL DISTANCE FROM CENTERS OF CONCENTRATED DRAINAGE. PORE-WATER PRESSURES DIRECTLY RELATED TO HEIGHT OF PIEZOMETRIC SURFACE REDUCE SOIL SHEAR STRENGTH UP TO 65 PERCENT AT THEIR MAXIMUM VALUE.
DATA INDICATE MAXIMUM PORE-WATER PRESSURES DEVELOP WHEN SOIL ZONE IS COMPLETELY SATURATED, REQUIRING RAINFALL INTENSITIES IN EXCESS OF 4 INCHES IN 24 HOURS--A 2- TO 5-YEAR RECURRENCE IN SOUTHEAST ALASKA.
- TARRANT, R. F. 12 67133
FOREST SOIL IMPROVEMENT THROUGH GROWING RED ALDER ('ALNUS RUBRA' BONG.) IN PACIFIC NORTHWESTERN UNITED STATES.
EIGHTH INT. CONGR. SOIL SCI. TRANS., BUCHAREST, ROMANIA, 1964, VOL. 5, PP. 1029-1043. (NO COPIES AVAILABLE)
COMPARED WITH OTHER SPECIES OF 'ALNUS' STUDIED THROUGHOUT THE NORTHERN HEMISPHERE, RED ALDER IS AT LEAST EQUALLY EFFECTIVE IN IMPROVING SOIL FERTILITY AND GROWTH OF ASSOCIATED TREES. SILVICULTURAL APPLICATION OF SOIL-IMPROVING AND TREE-GROWTH-PROMOTING QUALITIES OF RED ALDER IS CONSIDERED TO BE FEASIBLE AND DESIRABLE.
- TARRANT, ROBERT F. 5 67043
INSECTICIDE RESIDUES IN OREGON'S FORESTS. (ABSTR.)
IN 'PEST CONTROL PROGRESS AND PROBLEMS IN OREGON.' OREG. INTERAGENCY PESTICIDE COUNCIL. CONF. PROC. 1966, P. 30. (NO COPIES AVAILABLE)
- TARRANT, ROBERT F. 6 67058
PESTICIDES IN FOREST WATERS--SYMPTOM OF A GROWING PROBLEM.
SOC. AMER. FOREST. PROC. (1966), PP. 159-163.
WE ARE COMING TO DEPEND INCREASINGLY ON CHEMICALS TO ACCOMPLISH FOREST MANAGEMENT OBJECTIVES.
THE CURRENT CONCERN OVER PESTICIDE RESIDUES IN WATER IS CONSIDERED TO BE ONLY ONE, ALTHOUGH IMPORTANT, SYMPTOM OF AN INCIPIENT MAJOR FOREST PROBLEM--POLLUTION, SPECIFICALLY CHEMICAL POLLUTION.
- TARRANT, R. F., LU, K. C., BULLEN, W. B., AND *CHEN, C. S. 11 67087
CHEMICAL COMPOSITION OF THROUGHFALL AND STEMFLOW IN THREE COASTAL OREGON FOREST TYPES. (ABSTR.)
AGRON. ABSTR., P. 137. (NO COPIES AVAILABLE)
- TARRANT, ROBERT F., AND *NORRIS, LOGAN A. 8 67081
RESIDUES OF HERBICIDES AND DIESEL OIL CARRIERS IN FOREST WATERS--A REVIEW.
OREG. STATE UNIV. HERBICIDES AND VEGETATION MANAGE. SYMP. PROC. 1967, PP. 94-102.
REVIEW OF THE WORLD LITERATURE INDICATES THAT HERBICIDES AND THEIR DIESEL OIL CARRIERS CAN BE USED IN THE FOREST WITHOUT SERIOUSLY CONTAMINATING ADJACENT WATERS.
- THOMPSON, C. G. 5 67044
USE OF VIRUSES. (ABSTR.)
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- TORGENSEN, TOROLF R., AND BAKER, BRUCE H. 7 67082
THE OCCURRENCE OF THE HEMLOCK LOOPER ('LAMBDINA FISCELLARIA' [GUENEE]) (LEPIDOPTERA--GEOMETRIDAE) IN SOUTHEAST ALASKA, WITH NOTES ON ITS BIOLOGY.
U.S. FOREST SERV. RES. NOTE PNW-61, 6 PP., ILLUS.
AN INFESTATION OF HEMLOCK LOOPER ('LAMBDINA FISCELLARIA' [GUENEE]) ON STANDS OF SITKA SPRUCE ('PICEA SITCHENSIS') WAS DISCOVERED NEAR WRANGELL, ALASKA, DURING 1965. MOTHS WERE TENTATIVELY IDENTIFIED AS THE WESTERN HEMLOCK LOOPER ('L. F. LUGUBROSA' [HULTST]). THE IDENTIFICATION OF THE HEMLOCK LOOPER IS THE FIRST RECORD OF THIS INSECT IN ALASKA. BRIEF NOTES ON LIFE HISTORY, HOSTS, AND NATURAL MORTALITY FACTORS ARE GIVEN.
- TRAPPE, JAMES M. 9 67086
PRINCIPLES OF CLASSIFYING ECTOTROPHIC MYCORRHIZAE FOR IDENTIFICATION OF FUNGAL SYMBIANTS.
14TH CONG. INT. UNION FOREST RES. ORG. PROC., PP. 46-59.
MYCORRHIZAL FUNGI VARY MARKEDLY IN THEIR EFFECTS ON HOST TREES. RESULTS OF MYCORRHIZAL RESEARCH CAN BE ADEQUATELY INTERPRETED ONLY IF THE FUNGAL SYMBIANTS ARE KNOWN. IDENTIFICATION OF MANY SPECIES IS POSSIBLE THROUGH DEVELOPMENT OF KEYS THAT EMPHASIZE STABLE, MORPHOLOGICAL CHARACTERISTICS.
- TRAPPE, JAMES M. 6 67050
PURE CULTURE SYNTHESIS OF DOUGLAS-FIR MYCORRHIZAE WITH SPECIES OF HEBELOMA, SUILLUS, RHIZOPOGON, AND ASTRAEUS.
FOREST SCI. 13, PP. 121-130, ILLUS.
MORPHOLOGY AND ANATOMY OF MYCORRHIZAE FORMED WITH FOUR SPECIES OF FUNGI ON DOUGLAS-FIR 'PSEUDOTSUGA MENZIESII' (MIRB.) FRANCO ROOTS ARE DESCRIBED. A NEW, SIMPLE APPARATUS PERMITTED SEEDLING TOPS TO GROW IN THE OPEN WHILE ROOTS GREW IN PURE CULTURE WITH AN INOCULATED FUNGAL ISOLATE. THE NEED FOR PRESERVING VOUCHER SPECIMENS OF FUNGI REPORTED AS MYCORRHIZAL ASSOCIATES IS EMPHASIZED.
- VIERECK, LESLIE A. 1 67130
BOTANICAL DATING OF RECENT GLACIAL ACTIVITY IN WESTERN NORTH AMERICA.
IN 'ARCTIC AND ALPINE ENVIRONMENTS,' ED. BY H. E. WRIGHT, JR., AND W. H. OSBURN. PP. 189-204, ILLUS. BLOOMINGTON, INDIANA, INDIANA UNIV. PRESS.
BOTANICAL DATING SHOWS THAT THE GLACIAL ADVANCE IN THE PAST 300 YEARS IS THE GREATEST IN THE PAST 5 TO 10 CENTURIES AND PROBABLY THE GREATEST IN POSTGLACIAL TIMES. ALL REGIONS HAVE SOME INDICATION OF AN ADVANCE IN THE 1600'S, 1700'S, AND 1800'S, ALTHOUGH LOCAL AREAS MAY LACK EVIDENCE FOR ONE OR MORE OF THESE ADVANCES.
- VIERECK, LESLIE A. 10 67122
PLANTS ABOVE 2,140 METERS (7,000 FEET) IN THE ALASKA RANGE.
THE BRYOL. 70, PP. 345-347.
TWO VASCULAR PLANTS, 18 LICHENS, AND FIVE BRYOPHYTES WERE COLLECTED BETWEEN 2,140 M. (7,000 FT.) AND 2,354 M. (7,723 FT.) ON AN EXPOSED RIDGE OF AN ALPINE SUMMIT ON THE NORTH SIDE OF THE ALASKA RANGE.
- WALKOTTEN, W. J., AND PATRIC, J. H. 6 67055
ELEVATION EFFECTS ON RAINFALL NEAR HOLLIS, ALASKA.
U.S. FOREST SERV. RES. NOTE PNW-53, 8 PP., ILLUS.
RAINFALL ON A MOUNTAIN NEAR HOLLIS, ALASKA, WAS MEASURED IN BRUSH AND HIGH FOREST. TWENTY-ONE STORMS WERE SAMPLED DURING AUTUMN 1965. RAINFALL INCREASED 0.02 INCH PER 100 FEET OF ELEVATION FROM SEA-LEVEL TO 1,200 FEET, A RESULT REASONABLY CONSISTENT WITH OTHER EXPERIENCE.
- WALL, BRIAN R. 12 67114
1966 OREGON TIMBER HARVEST.
U.S. FOREST SERV. RESOURCE BULL. PNW-22, 2 PP., ILLUS.
CHRONICLES TIMBER HARVEST BY OWNERSHIP FOR 1950-66 AND GIVES DETAIL BY COUNTIES FOR 1966.

- WALL, BRIAN R. 10 67095
1966 WASHINGTON TIMBER HARVEST.
U.S. FOREST SERV. RESOURCE BULL. PNW-21, 2 PP., ILLUS.
CHRONICLES TIMBER HARVEST FOR 1950-66 AND GIVES DETAIL
BY COUNTIES FOR 1966.
- *WEBER, WILLIAM A., AND VIERECK, L. A. 6 67125
LICHENS OF MT. MCKINLEY NATIONAL PARK, ALASKA.
THE BRYOL. 70, PP. 227-235.
TWO HUNDRED EIGHTEEN SPECIES OF LICHENS ARE REPORTED
FROM MOUNT MCKINLEY PARK, ALASKA. TEN OF THESE HAVE
NOT BEEN REPORTED PREVIOUSLY FOR NORTH AMERICA.
- WILLIAMS, CARROLL B., JR. 9 67079
SPRUCE BUDWORM DAMAGE SYMPTOMS RELATED TO RADIAL GROWTH OF
GRAND FIR, DOUGLAS-FIR, AND ENGELMANN SPRUCE.
FOREST SCI. 13, PP. 274-285, ILLUS.
RADIAL GROWTH WAS DETERMINED BY ANALYSIS OF SAMPLE DISKS
AND RELATED TO FOUR DAMAGE CLASSES BASED ON AMOUNT OF
DEAD BRANCHES AND TWIGGS, AND THE EXTENT OF TOP KILLING
SEEN IN THE CROWNS. STUDY SUGGESTS CROWN VIGOR SYMPTOMS
CAN BE GROUPED INTO SEVERAL CLASSES SUITABLE FOR USE IN
DAMAGE SURVEYS.
- WILLIAMS, CARROLL B., JR., AND DYRNESS, C. T. 1 67004
SOME CHARACTERISTICS OF FOREST FLOORS AND SOILS UNDER
TRUE FIR-HEMLOCK STANDS IN THE CASCADE RANGE.
U.S. FOREST SERV. RES. PAP. PNW-37, 19 PP., ILLUS.
DISCUSSES FOREST FLOOR CHARACTERISTICS UNDER 46 TRUE
FIR-HEMLOCK STANDS FROM THE STANDPOINT OF DEPTH AND
WEIGHT OF FOREST FLOOR MATERIAL, HUMUS TYPE, AND AMOUNTS
OF AVAILABLE PLANT NUTRIENTS IN THE FOREST FLOOR.
- WITTIG, GERTRAUDE. 4 67031
EFFECT OF HEAT-STABLE 'BACILLUS THURINGIENSIS' TOXIN ON
ARMYWORMS.
J. INVERTEBRATE PATHOL. 9, PP. 1-2, PLUS COLOR PLATE.
HEAT-STABLE EXOTOXIN FROM 48-HOUR CULTURES OF 'BACILLUS
THURINGIENSIS' WAS INJECTED INTO SIXTH-INSTAR LARVAE OF
'PSEUDALETIA UNIPUNCTA.' THE TOXIN EITHER KILLED THE
LARVAE BEFORE COMPLETING PUPATION, OR IT CAUSED A DELAY
IN PUPATION AND THE OCCURRENCE OF UNEVENLY MELANIZED
AND MALFORMED PUPAE.
- WOODFIN, RICHARD O., JR., AND MEI, MARY ANNE. 7 67068
COMPUTER PROGRAM FOR CALCULATING VENEER RECOVERY VOLUME AND
VALUE.
PACIFIC NORTHWEST FOREST AND RANGE EXP. STA., 39 PP.,
ILLUS.
THE PROGRAMS ARE BOTH SPECIFIC IN MEETING THE NEEDS OF
THE TIMBER QUALITY RESEARCH PROJECT AND THE STUDY
- METHODS USED AND GENERAL ENOUGH TO PROVIDE VARIATIONS
THAT OTHER PROGRAM USERS MAY NEED. THE TWO PROGRAMS,
VR-1 AND VR-2, WILL DETERMINE VENEER GRADE RECOVERIES
BY LOG GRADE AND DIAMETER CLASSES. RECOVERY VALUES ARE
SUMMARIZED BY PEELER BLOCKS, LOGS OR TREE GRADES.
CUBIC VOLUMES ARE DETERMINED FOR BLOCKS, VENEER, CORE,
AND RESIDUAL. RECOVERY DATA MAY BE REPRICED OR CON-
VERTED TO OTHER THAN A 3/8-INCH BASIS. APPROPRIATE
PERCENT RECOVERY TABLES ARE PRODUCED.
- WOOLDRIDGE, DAVID D. 11 67107
WATER TRANSPORT IN SOILS AND STREAMS.
IN 'TRANSPORT PHENOMENA IN ATMOSPHERIC AND ECOLOGICAL
SYSTEMS.' AMER. SOC. MECH. ENG. PROC. 1967, PP. 3-20,
ILLUS.
THEORY AND CONCEPTS OF MOISTURE RETENTION AND FLOW IN
SOILS ARE REVIEWED AND RELATED TO SOIL PROPERTIES AND
SUBSEQUENT CONTRIBUTIONS TO STREAMFLOW. WATER IN
STREAMS IS DISCUSSED IN RELATION TO CLIMATE, AND FORESTED
AREAS AS A SOURCE OF STREAMFLOW ARE EMPHASIZED.
- WRIGHT, K. H., AND HARVEY, G. M. 9 67134
THE DETERIORATION OF BEETLE-KILLED DOUGLAS-FIR IN WESTERN
OREGON AND WASHINGTON.
U.S. FOREST SERV. RES. PAP. PNW-50, 20 PP., ILLUS.
AN 11-YEAR STUDY SHOWED THAT DETERIORATION INCREASED
FROM ABOUT 3 PERCENT THE FIRST YEAR FOLLOWING DEATH
TO 79 PERCENT AFTER 11 YEARS. RATE OF DETERIORATION
IS STRONGLY RELATED TO AGE AND SIZE OF TREE.
- *ZAIK, SAUL. 11 67109
WOOD FOR OUTDOOR LIVING.
PACIFIC NORTHWEST FOREST AND RANGE EXP. STA., 3 PP., (UN-
NUMBERED), ILLUS.
A PROMINENT NORTHWEST ARCHITECT SUGGESTS WAYS IN WHICH
WOOD CAN ADD LIVING SPACE AND PRIVACY TO HOMES AND
APARTMENTS BY ITS USE IN DECKS, SCREENS, SUNSHADES,
AND OTHER OUTDOOR ELEMENTS.
- ZAK, B. 4 67021
A NEMATODE (MELOIDODERA SP.) ON DOUGLAS-FIR MYCORRHIZAE.
PLANT DIS. REP. 51, P. 264, ILLUS.
A NEW NEMATODE, MELOIDODERA SP., WAS OBSERVED INFECTING
MYCORRHIZAE OF A 20-INCH D.B.H. PSEUDOTSUGA MENZIESII IN
WESTERN OREGON. ONLY TWO OF AT LEAST SIX MORPHOLOGIC-
ALLY DISTINCT MYCORRHIZAE ON THE ROOT SYSTEM WERE IN-
FECTED.

Headquarters for the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is in Portland, Oregon. The area of research encompasses Alaska, Washington, and Oregon, with some projects including California, the Western States, or the Nation. Project headquarters are at:

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